RADIO AND HOBBIES IN AUSTRALIA

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RECEIVERS FOR D-C POWER MAINS

RADIO AND HOBBIES IN AUSTRALIA

WHAT OF THE BATTLESHIP?

IT seems that, for the time being at least, the vexed question of plane-versus-battleship has been answered. The battleship was the natural development of the old style of naval warfare. It has grown in size from the cockle-shell craft of history to the 60,000-ton "battlewaggons" proposed for the US Navy.

The advent of more efficient bombing aircraft has gone a long way to render ineffective and obsolete the battleship's conventional protective screen of escort vessels. Indeed, the escort vessels themselves are by no means invulnerable to attack and destruction from the air. Hence the aircraft-carrier, whose job it is to accompany the naval squadron and to provide a protective "umbrella" of fighter aircraft should hostile bombers appear.

Simultaneously with the naval fighter has appeared the carrier-based dive-bomber and torpedo-bomber—deadly craft, capable of dealing out death and destruction on the same grand scale as the mighty 16in. guns, but more swiftly and over greater distances. Not so very long ago the world witnessed, in the Coral Sea, a naval battle of major importance in which not a single surface ship fired a shot at an enemy ship. Over two hundred miles of ocean, planes sped backwards and forwards with their bombloads, seeking to cripple one another's carriers first, and then other vessels as an afterthought.

With the development of this new and flexible offensive weapon, the battleship appears almost superfluous, employed because they are available, because other nations still have them and because there are as yet not enough powerful bombers to drive them off the ocean. At the moment, the opposing nations are engaged in a frantic race to obtain aircraft-carriers at all costs.

Already it has been demonstrated that the carrier is a very vulnerable ship when faced with shore-based bombers. Fortunately for the Allies, the lesson was learned at the expense of Japan. Japanese naval planes, with the inherent limitations imposed by the restricted land and take-off area, were helpless to protect the mother ship.

It may be, therefore, that the aircraft-carrier will prove to be only a compromise—a product of the transition from war on the sea to war in the air. When the time comes, as it inevitably will, that the range of bombing aircraft rises to 10,000 or more miles, with a corresponding increase in speed and disposable load, the carrier may prove to be an insignificant and unnecessary detail. It will no longer be necessary for a ship to plough thousands of miles with a handful of small planes.

Merchant ships may still be necessary to carry freight for a long time to come, but it seems that the battle to protect them—battle for the sea-lanes—will be fought in the skies.

Of course, this leaves out the possibility of scientists developing some startling new weapon for protection against attack from the air. As yet, no such weapon has appeared. Balloon barrages, rockets and parachutes trailing wires and other such devices fill a useful place, but they merely hamper the attackers and are scarcely to be reckoned as weapons of offence.

Anti-aircraft fire is very limited in its offensive value. Too much can happen between the time that the gun is set and the missile reaches the vicinity of the target. It yet remains for science to produce a missile automatically directed to the target by visual means or by reflected radio waves.

However, such a weapon could be turned around with deadly effect. Gravity is all on the side of the aeroplane when it comes to war in a vertical plane.

W. G. Williams

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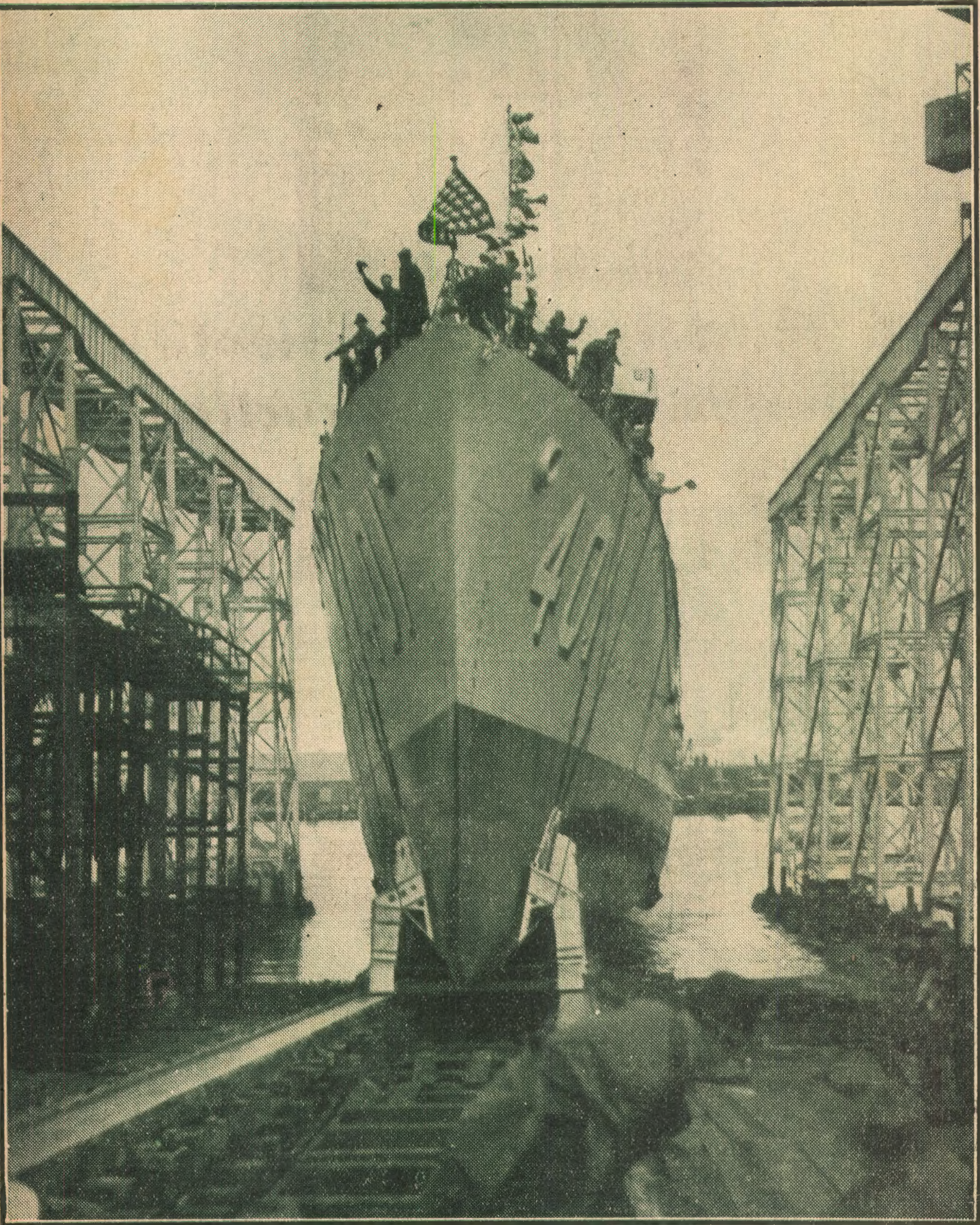
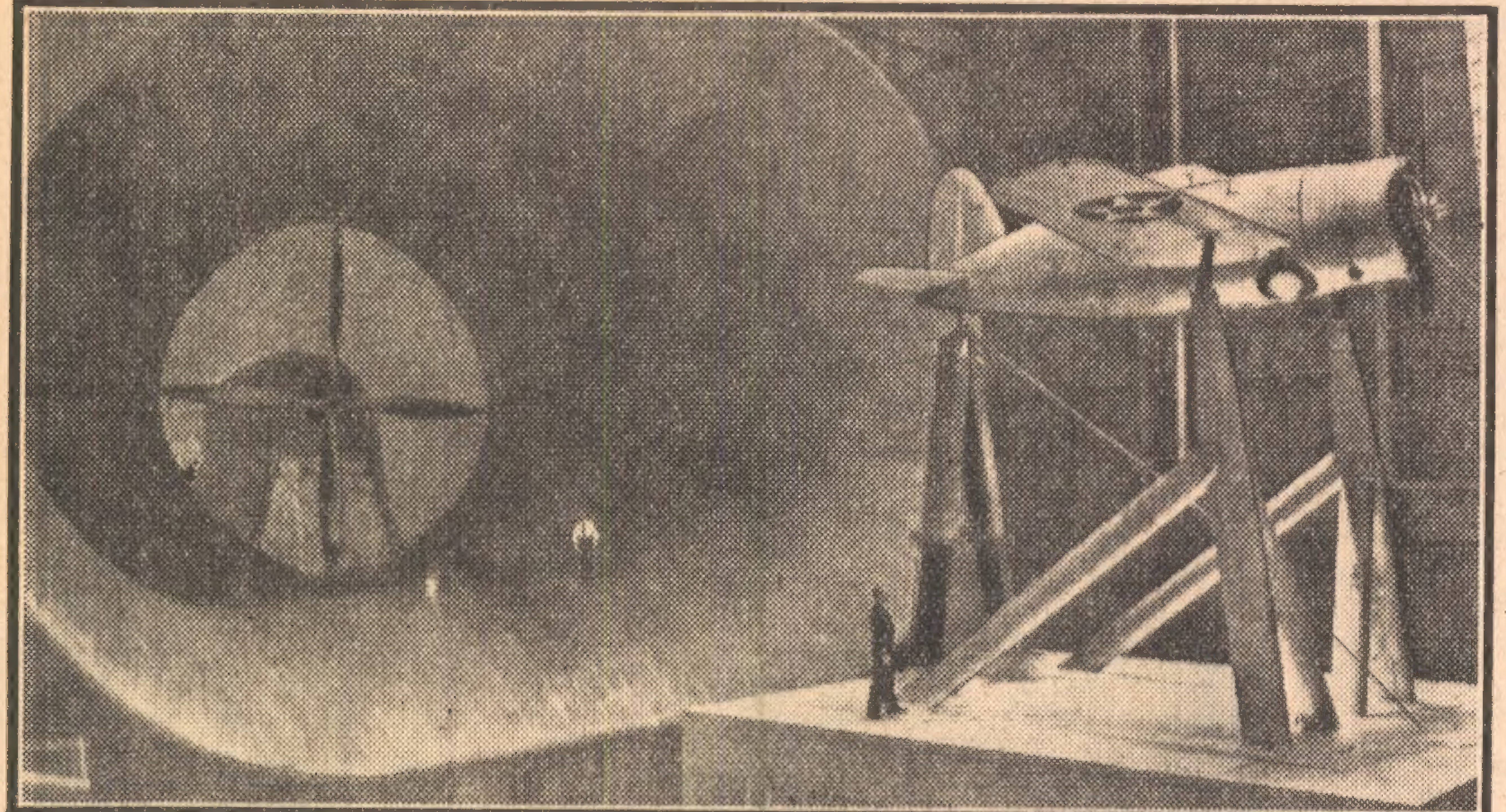
THE VITAL BATTLE OF THE SLIPWAYS



Axis submarines and surface raiders are striving hard to cut the vital lifelines of the allied nations—to prevent the flow of munitions of war from the factory to the front. Allied shipyards are working at top pressure, turning out merchant ships to replace those sunk, warships to challenge the menace.

AMERICA'S VAST AIRCRAFT PROGRAMME



The huge wind-tunnel at Langley Field, in which experiments can be carried out on full-sized combat aircraft. The delicate measuring instruments are connected to the struts supporting the plane and housed in the room immediately beneath it.

★

Nearly every day the enormous striking power of the modern air force is brought home to us—great battleships are sunk, great cities laid waste, great armies demoralised. An essential of the modern aerial blitz is attack in force—attack not by dozens but by hundreds, even by thousands of bombers. Is this mass production possible to the United Nations—and how does our production potential compare with that of Germany?

FOR true mass production of planes we must undoubtedly look to America. In the development of aeronautics America has led the world. Australia may have its Hargraves, France its Bleriots; Englishmen may have flown the Atlantic long before Lindbergh thought of it.

But modern aviation really began at Kittyhawk, North Carolina, when the Wright brothers, for the first time in man's conquest of the air, lifted a plane off the ground and sustained it in flight by mechanical means.

THE LIBERTY MOTOR

During World War 1 Americans found themselves in competition with Europe's hand-made aeroplane engines; they solved production problems in true American fashion. They evolved the famous Liberty motor, which, at that time, was probably the best all-round aeroplane engine in the world—designed, built, and tested in thirty-six days!

Getting it into production was a real headache. Nevertheless, it was being produced at the rate of 46,000 a year when the Armistice came. The American Army plane with the Liberty motor never did get to Europe—only some American-built planes of English and French design. But the enormous production potential was there, just the same!

For the best part of twenty-five years the American aeroplane industry has been all tailoring and no pants, which is another way of saying that it has been all science and no production. Far better that it should be that way than the other way around. For the matter of production is something in which the Americans specialise.

The ability to produce large quantities of inferior machines is not nearly as valuable as the American ability to produce large quantities of the best planes the world has ever seen. Had they been lacking in aeronautical science and aircraft technique, there would really have been something to worry about.

by

L. B. Montague

One important difficulty in the road of satisfactory mass-production of aeroplanes is that it might take anything up to 1000 scientists, engineers, technicians, designers, and draughtsmen to produce a single combat plane.

By the time the authorities have tested the plane, supervised the alterations thought necessary, and then ordered a few, the plane would already be obsolete. Remember the Douglas B19, which took four years to produce?

This, of course, is the reason why Hitler has "frozen" designs of his fighters and bombers. To build another B19, by the same method as previously used, would take only a year or so, but it would be out-of-date before it was begun.

You see how it is—a science and a craft always evolving together, with science well ahead and "no place to stop."

We all know that there is a lot to consider in the building of a plane, but exactly how much most of us have no idea.

In America there is a body known as the National Advisory Committee on Aeronautics, which collects all data on aeroplanes, sets safety standards, keeps a fatherly eye on the industry, and has committees of experts continuously investigating all technical problems.

FOUR COMMITTEES

There are four principal committees, one on aerodynamics, one on engines, one on materials, and one on structures. Each of these subjects is a field in itself. Aerodynamics is the study of shape and design and the behavior of a body in the air medium under all conditions.

The study of structures concerns itself with stress and strain—such, for example, as the cruelty to rivets, struts, ribs and fastenings when the bomber pulls out of a vertical dive and begins climbing out of the anti-aircraft fire, or, again, when something like the tip of a propeller blade is moving at the speed of sound.

A few of the subjects covered by the study of aerodynamics are: High-life devices, control and controllability, manoeuvrability, longitudinal and lateral stability, control surfaces, the "flow of compressible fluid past a sphere to

A STORY OF AERONAUTICAL RESEARCH

the third order of approximation," vibration and flutter, and gust structure—the structure of a gust of wind, vertical and horizontal.

Engines cover: Fuels, lubricants, power recovery from the jet propulsion of exhaust gas, a flat engine inside a wing and how to cool it, and the supercharger problem.

Materials: Welding and riveting of joints, rivets that won't disintegrate, fatigue tests of stainless steels, aircraft metals at sub-zero pressures, plastics opaque and transparent.

Structures: Photoelastic analysis of three-dimensional stress systems, torsional instability of columns, stress distribution in "monocoque" (shell-like) structures, ribs in stressed skin structures, and so on.

TESTING MODELS

The development of the actual plane itself starts with the modelling ability of young men who produce in wood and plastic the miniatures incorporating the ideas that come from the department of aerodynamic research—a cleaner line here, a modulation of the airfoil surface so slight that the untrained eye cannot see it, a slotted flap, a plain flap, an experimental tail surface, and so on.

The finished model goes to a wind tunnel, where the conditions of flight are simulated, while every movement of the model in the windstream, of controlled and variable velocity, is measured; the resistance the model offers to the wind—that is measured, too, by observers outside, looking through glass partitions.

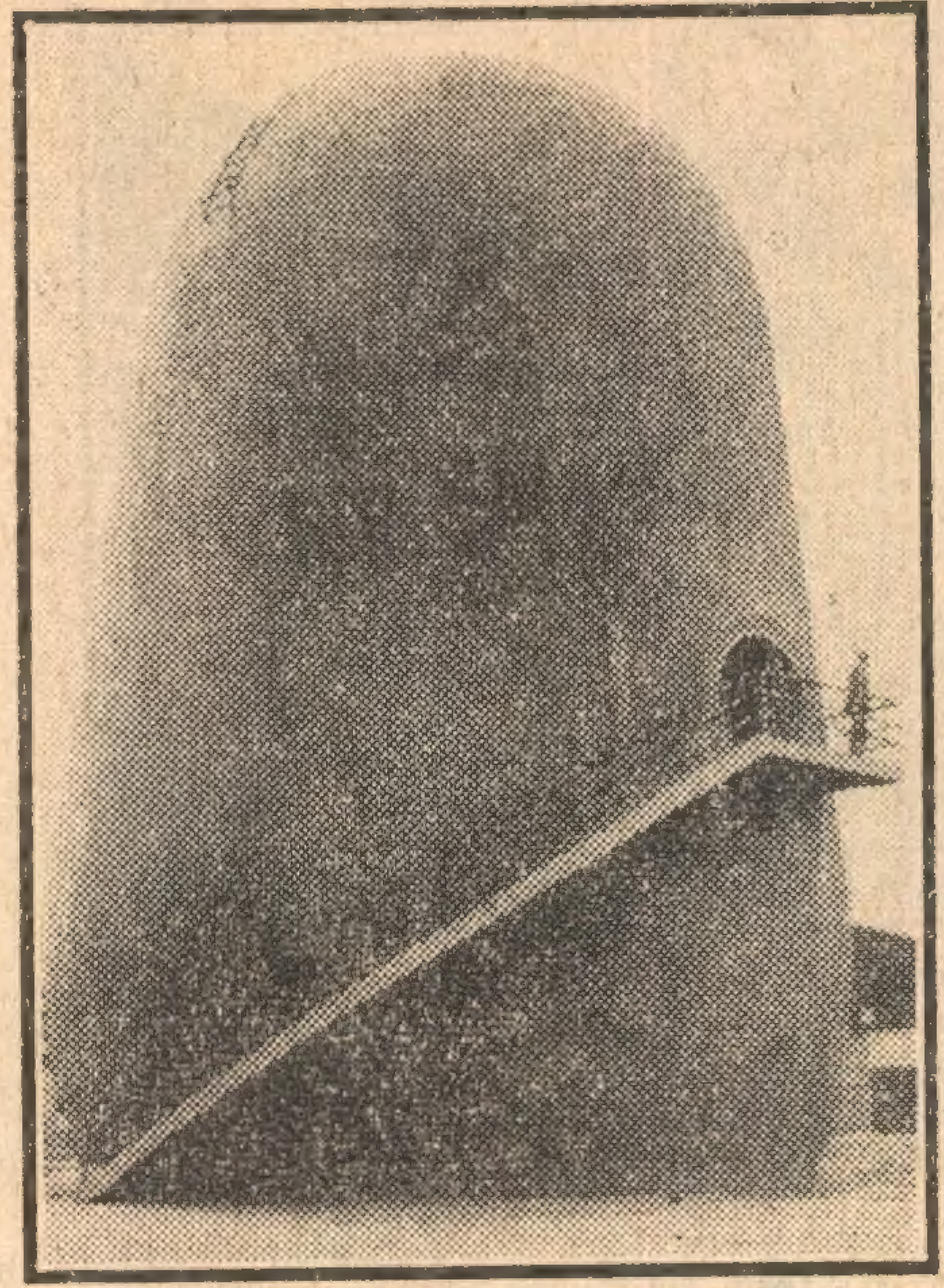
The behavior of the model in the windstream is observable; the behavior of the wind is not. Most important, how does the boundary layer behave?

The boundary layer is the very thin stratum of air that slips on the surface of the wing. It flows smoothly at first and for some distance back from the wing's leading edge, but there is a point at which it breaks and becomes turbulent, and there the bad drag begins. The less turbulence, the less drag; the less drag, the more speed.

PHOTOGRAPHING AIR

It is a minor wonder that the turbulence of the air can be photographed. What happens to the air in contact with a body moving through it at the velocity of sound—even that can be photographed. And by study of these photos of wind waves, wind bubbles, air turbulence and eddies, under conditions of exact observation, the aerodynamic researchers get further ideas about the perfect shape of an aeroplane.

Of course, the wind tunnel can only simulate actual flying conditions. In a model falling to its destruction in the spin tunnel (a vertical tunnel specially designed for the study of spin), there would be no pilot giving it up and starting to bail out, only to find that, just as he was about to pile out, the shifting of his weight has caused the plane to bring itself out of the spin. This incident, duly reported, takes its place in the committee's vast store of fact data.



Looking rather like a giant anthill, this vertical wind-tunnel is one of several set up at Adlershorst, near Berlin, by the German Experimental Institute for Flying. In the smaller wind-tunnels of this nature, the tests are carried out on scale models of service planes.

DESIGN AND PRODUCTION

When the designers prophesy a speed of, say, 300 miles for a plane, and then watch the plane go into production, they hold their breath for maybe a year. The plane manufacturers would not, of course, alter the shape of the plane in any way that anyone would expect to make any difference, but, in solving his own practical problems, he might do a little thing here and a little thing there; the plane that emerged, when it came to the test, would do only 275 miles.

Had science been over-dreaming, or had 25 miles been lost in the hands of the plane-maker? No argument could settle the question; it would have to be demonstrated. And for that purpose there is at Langley Field a full-size wind tunnel where the behavior of the plane itself in the wind stream can be studied as if it were a model.

The task of the aerodynamic engineers then is to clean up the plane-maker's job—that is, to eliminate the drag caused by what he did with his wind ducts or where and how he stuck out his exhaust-pipes.

SMALL POINTS

Cleaning up the famous Bell "Airacobra" in the full-size wind tunnel added something like fifty miles to its speed.

Shape and design, as you can see, are of great importance. But, besides these two, there is the skin, which means the smoothness and texture of the surface on which the air slips, and this is in itself one study.

The difference between roundhead and counter-sunk rivets, fastening the edges of the metal skin together, may be as much as ten or fifteen miles in the speed of the plane; the difference between a surface only as smooth as paint spray can make it, and a highly-polished surface could be as much. The ideal

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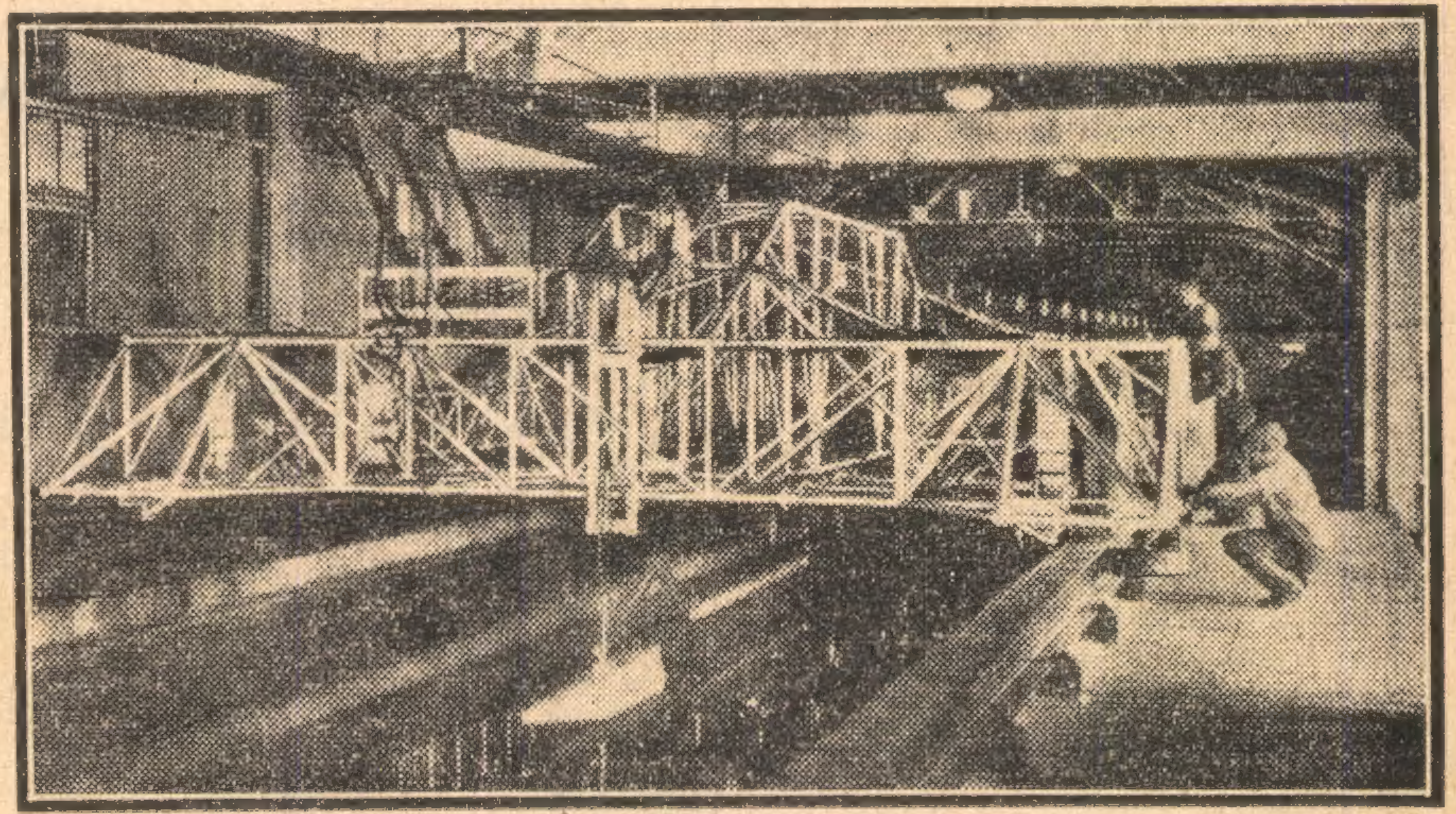
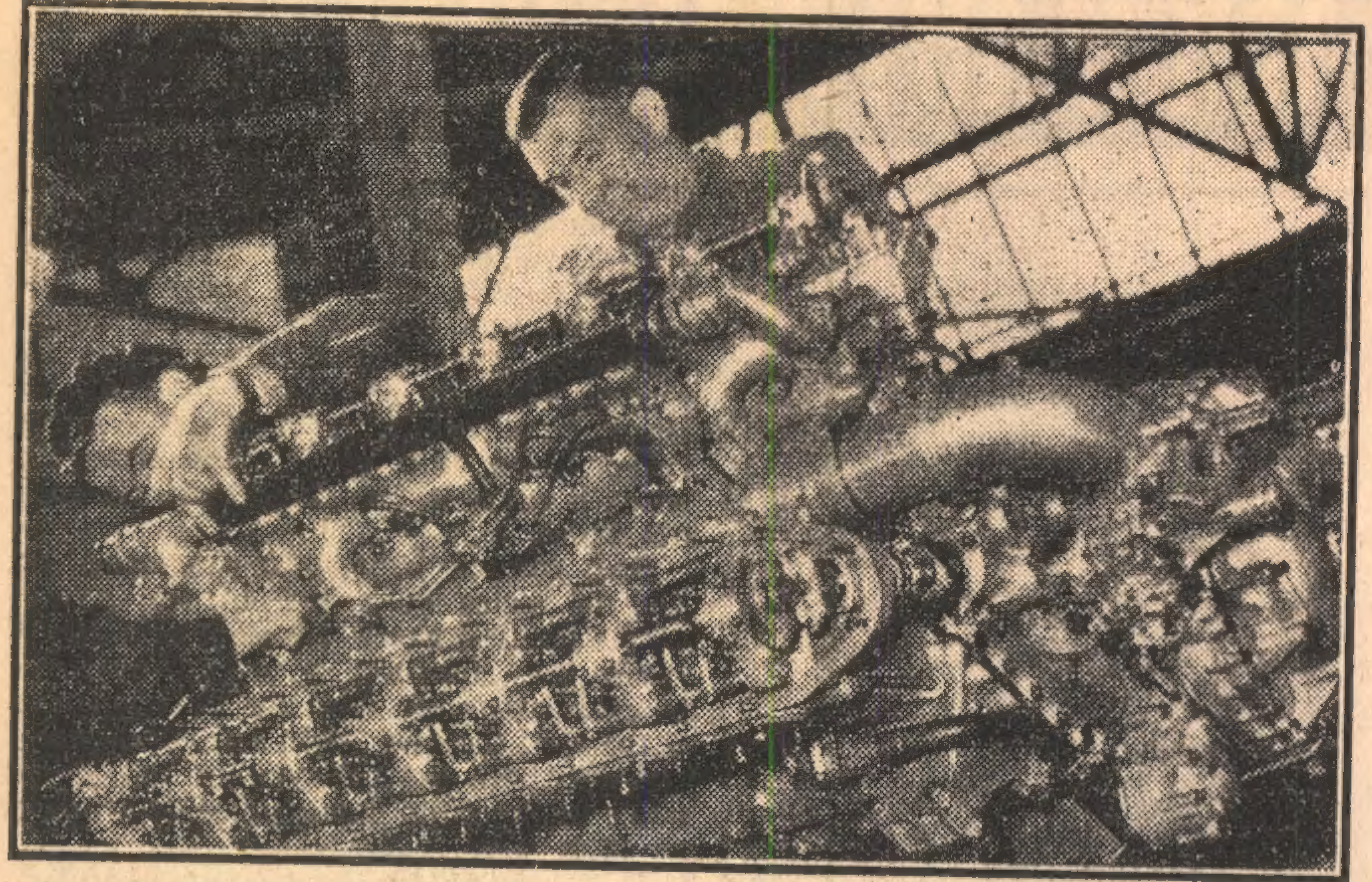


A view of the longest seaplane towing channel in the world at Langley Field, VA. The hull or float to be tested is drawn along beneath the electrically driven towing carriage and its action in the water observed. The channel is 12ft. deep, 24ft. wide and half a mile long.

THE HEART OF A MODERN FIGHTING PLANE



A modern airplane engine must combine enormous power with the lowest possible weight and the smallest possible frontal area. Its cooling system must not be too vulnerable nor yet such as to create excessive drag by virtue of wind resistance. These requirements set it in a world apart from the simple robustness of the average auto engine.

surface would be something like a piano top—which may yet be achieved with a plastic of some kind.

As the mass and speed of seaplanes increased, there came a serious problem of "bobbing" when taking off and coming down, because the pontoons or hulls were not the right shape. But how could you see what was happening in the water at a speed of 70 or 80 miles an hour to make the hulls behave so dangerously?

At Langley Field there is a narrow canal, more than half a mile long, with a track on each edge. Running on the track, a-straddle the canal, is a forked electric locomotive that drags a seaplane model through the water at eighty miles an hour.

The conditions of a seaplane's taking-off and coming down are thus simulated, the bobbings are observed and measured instrumentally, and, by trial and error, the hulls are re-designed until the trouble is licked.

Two kinds of spray are thus identified, velocity spray and pressure spray. Still unknown was the behavior of the water beneath the hull. To find that out, a model with transparent bottoms was dragged up and down the canal.

THE AIRPLANE ENGINE

So far we have not touched on what makes an aeroplane go—the engine.

The aeroplane engine is a racehorse; the finest automobile engine, by comparison, is a mule. That does not mean the motor-car industry cannot make an aeroplane engine. It merely means that the car manufacturer works within certain tolerances of accuracy, suited to the purpose for which the car engine is intended.

An engine refined and tuned to the pitch of an aeroplane engine does not belong in a motor car; indeed, it would be a liability there, neither very durable nor very serviceable.

Let us consider the aeroplane engine; a six-foot package weighing less than one solid horse, yet delivering the power of 1000, 1500, or even 2000 horses. One pound of engine per horse-power, compared to the five or six pounds of engine per horse-power in your car.

Everyone else was adding weight to the aeroplane, instruments, gadgets, armor and cannon, and demanding of the engine-maker all the time more power for less weight.

ENGINE COOLING

There are two kinds of aeroplane engine and each has its own band of loyal supporters—air-cooled and liquid-cooled. As you know, an internal combustion engine would run red-hot in a few minutes if it were not somehow cooled.

The air-cooled engine has fins around the cylinders to radiate away the heat. Note the engine on a motor-cycle. That is air-cooled.

In the liquid-cooled engine, which is the kind you have in your car, the cylinders are entirely surrounded by a circulating liquid. The fan and radiator are to cool the liquid, and there is a pump to keep it circulating.

The endless controversy as to which cooling method is best is all to the good, for it keeps both sides in competition and, incidentally, gives us yet another example of the constant research and experimenting that is continually carried on.

But whether it is air-cooled or liquid-cooled, the engineering and mechanical practice is the same. Every moving part of the engine, even the connecting rod, is ground and polished to a mirror surface, in order to eliminate machine-tool scratches.

For it is in these minute valleys that failing stresses often begin. The sharp edge of each part is rounded by grinding and filing, a process which is necessary because, when a piece of metal begins to move at the speed of a humming-bird's wing, the stress and vibration are such that fractures and tearing may start from a sharp edge.

ASSEMBLY PROBLEMS

For example, the cylinder is a very thin, highly polished bracelet; yet that bracelet will contain a violent gas explosion upon the head of a throbbing piston more than 3000 times a minute, which is more than fifty times a second.

Out of thousands of these beautifully polished parts, skilled workmen assemble the engine, never making a sharp or sudden movement. The setting of a nut one hand's pressure too tight may be ruinous. An engine assembled by one crew may be perfect. One assembled from identical parts by another crew may kick itself to death in the first hour.

When the engine is assembled, it has the quality of a jewelled watch and the power of a locomotive. It goes now to the torque room, where it is bolted

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JAPANESE TWO-MAN SUBMARINE

ON the opposite page is a pictorial view of a Japanese two-man submarine. From an English source, this drawing is evidently based on information obtained from an examination of the submarine captured during the attack on Pearl Harbor.

Although, as yet, few details have been made public of the submarines which recently attacked Sydney Harbor, it seems likely that they are similar to, if not identical with, those used at Pearl Harbor.

Recent reports from Europe are to the effect that Germany is proceeding with the construction of miniature submarines, with the immediate intention of transporting them overland to the Black Sea. Whether these German submarines will follow the Japanese pattern is quite another matter.

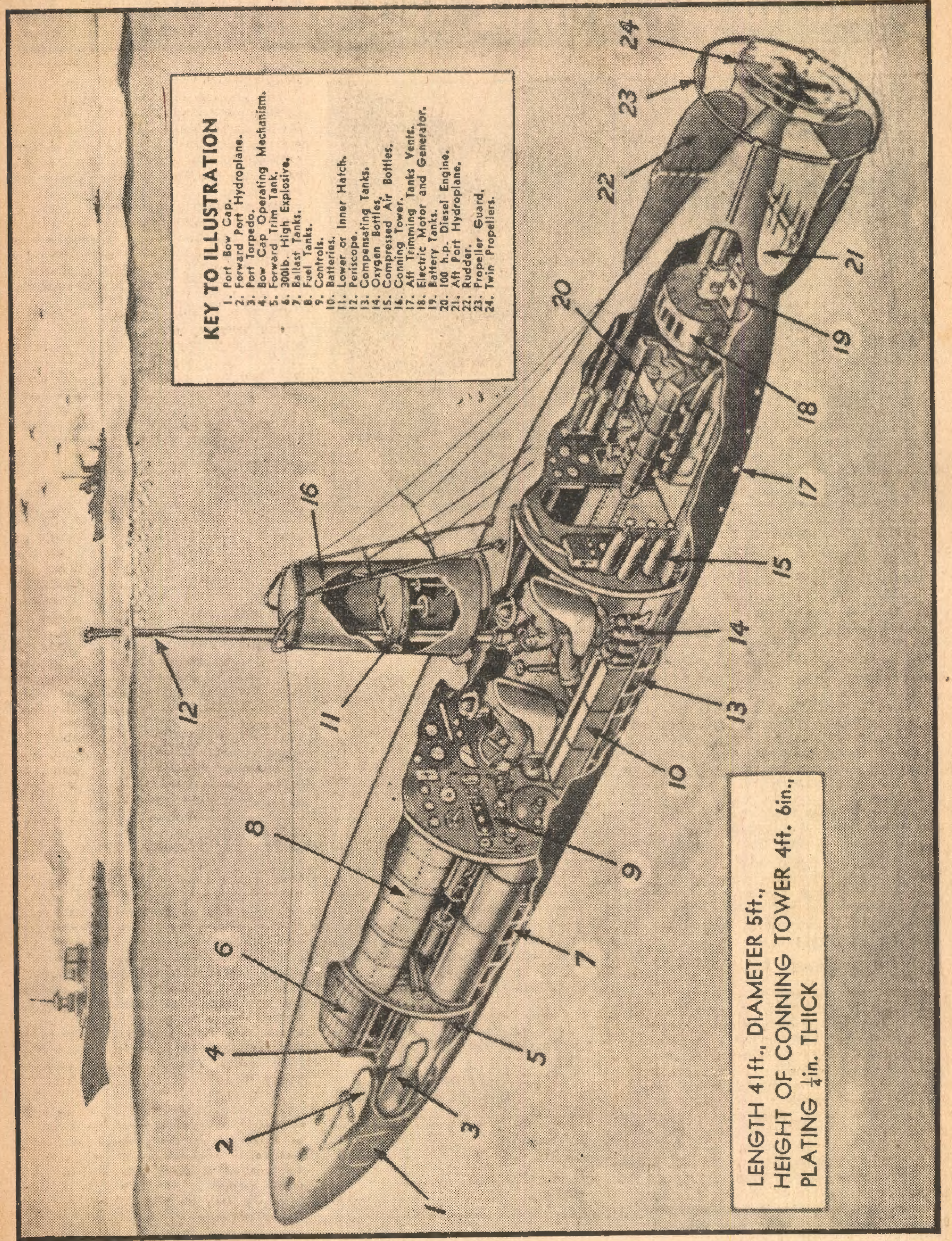
Examination of the illustration opposite shows that the Japanese submarines are fitted with a diesel as well as an electric motor, which would probably permit recharging of batteries as well as night cruising on the surface. However, fuel capacity would be very limited.

The limited cruising range puts them rather in the class of "suicide" craft, since there is little chance of them making their way back to their base or mother ship after having launched an attack. The 300lb. of high explosive in the nose suggests that they are intended to be used as a directed torpedo, after having fired the two normal torpedoes in the bow.

There is no suggestion of any radio equipment, although this could probably be fitted for certain purposes as, for example, to acquaint heavier ships with the location of specific targets within enemy harbors.

For the rest, the illustration is more or less self-explanatory.

PICTORIAL VIEW OF A JAPANESE TWO-MAN SUB



YOUR HEART WORKS NINE HOURS A DAY!

In hospitals all over the world, precious lives are being saved by blood transfusions. The blood of the donor must fall in the same grouping as that of the patient, otherwise the result may be fatal. Our picture shows a pathologist at work at an Australian hospital "typing" blood samples.

In these days of anxiety and high pressure living, the human organism is subjected to great stress and strain. Of all the organs of the body, the heart is the one that is most likely to suffer. This wonderful piece of machinery is the pump on which we depend to force the nourishment derived from our food to every part of our body.

THE heart is situated near the upper chest cavity and looks like a pear-shaped pouch with extremely powerful muscular walls. In an adult, the heart weighs from about 9 to 11 ounces.

It is a common mistake to imagine that the heart works ceaselessly night and day, year in and year out. This is not really the case, for the heart must have rest. The actual work of the heart is done whilst contracting, in the process of pumping the blood through the circulatory system.

HEART ACTION

For the heart does not really beat. There is first a contraction of the muscles which cause the blood to be forced out of the heart. A good illustration is that of a syringe. If a syringe is filled with water, a squeeze of the bulb will force the water out. The subsequent release of the bulb can be compared to the relaxation of the heart after contraction.

There is a pause after each relaxation before the next contraction. These relaxations and the subsequent pauses total about 15 hours in each 24. Thus the heart really works only nine hours a day.

It is during these pauses that the heart feeds itself. The fact that the heart only moves about six ounces of blood at each stroke is no indication of the amount of work it does.

When it is considered that the heart beats about 100,000 times a day, and that the work done is equivalent to moving 12 tons every 24 hours, some indication can be gained of the real amount of work done.

There are actually three walls in the formation of the outside casing of the heart. An outside coat, a very powerful muscular middle coat and a thin inside lining which is very delicate. The valves of the heart are a continuation of this inside lining.

The heart is divided vertically down the centre and thus forms two chambers or pumps. These two chambers are

by Calvin Walters

again divided by a partition across the heart. Thus there are four chambers—two upper, which are called "auricles," either right or left, and two lower, or "ventricles," either right or left.

Situated in the cross partitions are the valves, which perform a very important function. Their purpose is to "bottle" the blood in such a way that the contraction of the heart will force the blood into the right channels for circulation.

When the blood has passed through the body, it is gathered up in large veins and carried back to the heart, being poured into the right auricle or upper chamber.

This blood is impure, being dark in color and lacking in oxygen. From the auricle, the blood passes through the valve into the right ventricle or lower right chamber. When this chamber is full the valve between the auricle and ventricle closes so that the blood cannot pass back into the auricle when the contraction of the ventricle takes place.

When the ventricle is full, as described, the heart contracts and forces the blood through what are called "semi-lunar" valves, situated between the right ventricle and the pulmonary artery. The blood is thus passed through the lungs, where it rids itself of the carbon dioxide and becomes enriched with oxygen.

The veins in the lungs, or pulmonary veins, carry the blood back to the heart, into which it pours through the left auricle. It is bright red in color, and is now ready to be pumped through the body.

From the left auricle it flows into the lower or left ventricle through the valve between. When the left ventricle is full the valves close, and the next contraction forces the blood through a valve into the "aorta," to be sent all over the body.

BLOOD CIRCULATION

The aorta is a large artery and, as the series of arteries progresses, they get smaller and smaller, finally entering the smallest tubes, which are called capillaries.

Thus through the capillaries the blood reaches every part of the system, and it is in these capillaries that the process of "osmosis" takes place.

Osmosis is the process whereby the food from the blood is exchanged for the waste matter that has accumulated in the system.

Having accumulated the waste, the blood is again ready to be taken back to the heart. A drop of blood takes about half a minute to go through the cycle and return to the heart.

Food is absorbed by the blood in its passage through the capillaries of the intestines, &c.

The action of the heart is entirely automatic, and it starts its own beat

YOUR BLOODSTREAM IS A BATTLEGROUND

which is regulated by two sets of nerves One nerve is the "sympathetic nerve" and the other is the "vagus" nerve. The "sympathetic" nerve makes the heart work faster and the "vagus" nerve makes it slower, so that a fine balance is constantly maintained.

The red color of the blood is due to a substance called "Haemoglobin," which has the property of absorbing the gas oxygen. When Haemoglobin loses its oxygen it becomes a dark red color, and is a bright red when it has absorbed oxygen.

Blood consists of millions of cells suspended in a liquid called "Plasma." The cells are living cells and are of two kinds, red cells, called red corpuscles, and white cells, called white corpuscles.

Red cells contain the Haemoglobin, and, in normal blood, there are about five million red cells to the cubic millimetre and 7500 white cells. There is about 90 per cent. Haemoglobin in a cubic millimetre of blood.

RED CORPUSCLES

In women, the percentage of red corpuscles is slightly lower. Normally, there is an increase of red cells in people living at high altitudes, so that at 2000 feet, the red cells may be increased by about 200,000, and at 6000 feet above sea level the red cells may increase by 500,000 in each cubic millimetre.

The unit of measurement in blood work and bacteriology is the micron. It is the 1000th part of a millimetre, and as a millimetre is about one-twenty-fifth of an inch, the micron is a one-thousandth part of one-twenty-fifth of an inch.

A normal red cell is 7.5 microns in diameter and two microns in thickness, so that it is rather small.

Red cells are formed in the marrow of the bone and the average life after leaving the bone marrow is about 30 days. On this basis, one-thirtieth of the total number of red cells are destroyed each day. These old, or damaged, red cells are destroyed in various organs of the body, such as the spleen.

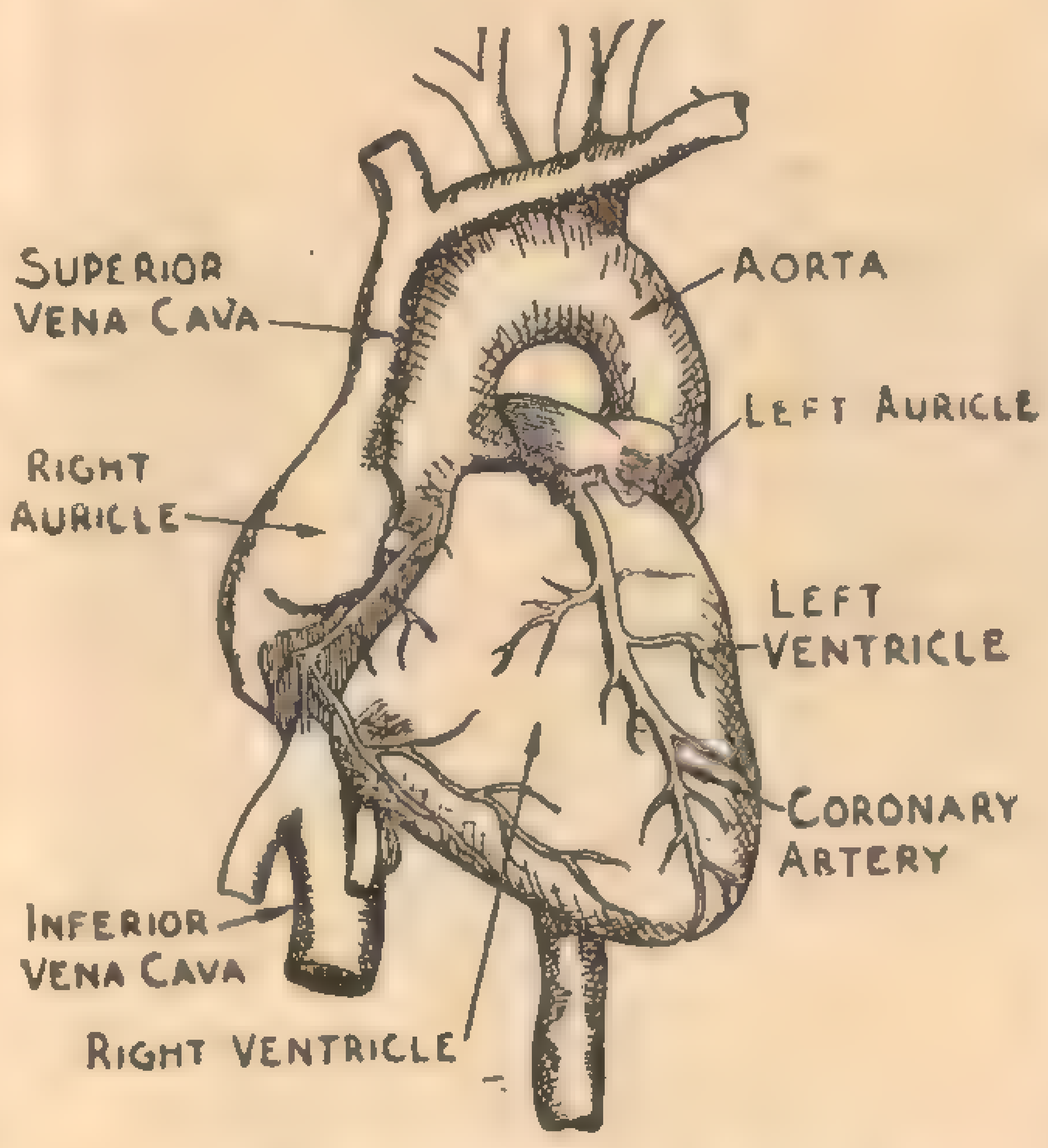
WHITE CORPUSCLES

Fortunately, the bone marrow is continuously manufacturing new red cells and even after considerable loss of blood is pouring out red cells under real mass production conditions.

The white cells of the blood are technically called "Leucocytes." The views as to origin, nature and functions of Leucocytes are rather confused. However, it is known that they have a very important function of digesting and gathering foreign matter, including bacteria that may have entered the blood stream.

They are really the scavengers of the body. When a disease that induces inflammation attacks the body, the white cells immediately take charge and flow to the infected spot in increasing numbers. Here they immediately attack the germs, and, if the blood is healthy, it is possible that the infection will be arrested; the white cells get the upper hand and the germs are killed off.

If some of the blood is taken from



An outline drawing of the human heart. As explained in the text, the interior of the pear-shaped portion is divided into four main compartments with interconnecting valves.

around a boil, or in any spot where inflammation is evident, it will be seen to have a large increase in the number of white cells.

Under the microscope, these white cells will be actually seen with the bacteria inside them. This has a very important bearing on the question of vaccine therapy and immunity by inoculation.

Inoculation and vaccination are now extensively practised, especially in the case of men on active service. Immunity against certain diseases, such as diphtheria and whooping-cough, is a recent addition to medical practice.

Such diseases as typhoid in its various forms of para typhoid "A" and "B," tetanus or lockjaw, dysentery, meningitis, anthrax, &c., are very responsive to treatment by vaccines.

Conversely, immunity can be acquired against those diseases by one of the following methods:—

(a) By injection of the live germs in minute non-lethal doses.

(b) By injection of the dead organisms.

(c) By injection of the poisonous products of bacteria in small doses.

(d) By injection of the living but attenuated organisms.

ANTI-TOXIN

There have been several theories to account for the phenomenon of immunity. The one most widely accepted today states that, when an animal is rendered immune to a toxin or poison generated by a germ, a substance known as "anti-toxin" is developed in the blood, which has the power of neutralising the toxin of the germ.

The white cells also contain what are called "phagocytes," and it is these phagocytes which, according to one theory, ingest and destroy bacteria that enter the blood stream.

This theory calls this "educating the phagocytes." By this is meant that, if a vaccine made from the germs in the manner described above is injected in small quantities into the blood stream, the phagocytes gain some idea of what they are expected to cope with in the event of a real invasion of live and virulent germs.

Thus, no time is lost by the phago-

(Continued on Next Page)

Drawing off samples of a donor's blood by means of a large hypodermic syringe. Blood can most conveniently be taken from the large vein which is usually visible beneath the skin at the point where the needle is inserted.

cytes in developing an offensive strategy to combat this invasion.

Vaccines are made from the live germs of the particular disease in the following manner:—

A pure culture of the germ is taken and emulsified in a solution of sterile salt. This is sterilised either by the addition of small quantities of carbolic acid or by prolonged heating.

The number of germs in a cubic centimetre are counted and a correct dilution made. Dosage is according to the disease and severity.

In the case of protective serum, the disease germs are injected in minute non-lethal doses into the blood stream of a horse. As the horse acquires immunity, the dosage is gradually increased, and, after a time, the horse is entirely immune to that particular disease.

Blood is now taken from the horse and the serum, or plasma which separates from the red blood cells, is collected and sterilised. This constitutes the serum that is then injected into the blood stream of the patient, and which renders this patient immune to this disease.

In wartime, as well as in peacetime, blood transfusions take a most important part in the saving of life. Great loss of blood is, of course, dangerous and very often the system cannot make up the loss quick enough to save the life of the patient.

AID FOR WOUNDED SOLDIERS

The chance of recovery for a soldier wounded in battle is now much higher than it has been in the past. Blood for transfusion, duly classified and held in store, can be rushed in mobile refrigerators to the forward areas where it is needed.

BLOOD TRANSFUSION

Blood transfusion has then to be resorted to. The technique is, roughly, as follows:—

First of all, the donor has to be selected. Nowadays, blood banks have done away with the necessity of hurriedly searching for a donor.

The donor is selected by testing his blood against the blood of the recipient or patient.

This is done by taking a small quantity of the donor's red cells and mixing them with a small quantity of the patient's blood serum. This mixture is placed on a glass slide.

A small quantity of the donor's blood serum is also mixed with a small quantity of the patient's red cells and the mixture placed on a glass slide.

After a lapse of a few minutes the two slides are examined under the microscope, and if any evidence is found of clumping together of the red cells in both cases the donor is rejected. If no evidence is found, then the donor is suitable.

If the blood of an unsuitable donor was injected into the blood stream of the patient the red cells of the patient would coagulate, with fatal results.

The above method is used in emergencies as being the quickest under the circumstances.

In the case of blood banks, voluntary donors have their blood examined to determine under which of four groups they fall. Either of groups 1, 2 or 3 must only be injected into the same groups, but group 4 can be used to transfuse into any group at all, although it is preferable to use like groupings where possible.

To the needle is connected a rubber tube, which is lead into a flask containing 3 per cent. sodium citrate solution. The citrated blood is then passed directly into the vein of the patient through another needle.

RECENT PROGRESS

More favorable results have been obtained by agitating the blood as it flows into the flask, using no sodium citrate at all. This has the effect of preventing the blood from coagulating, and results seem to be more positive.

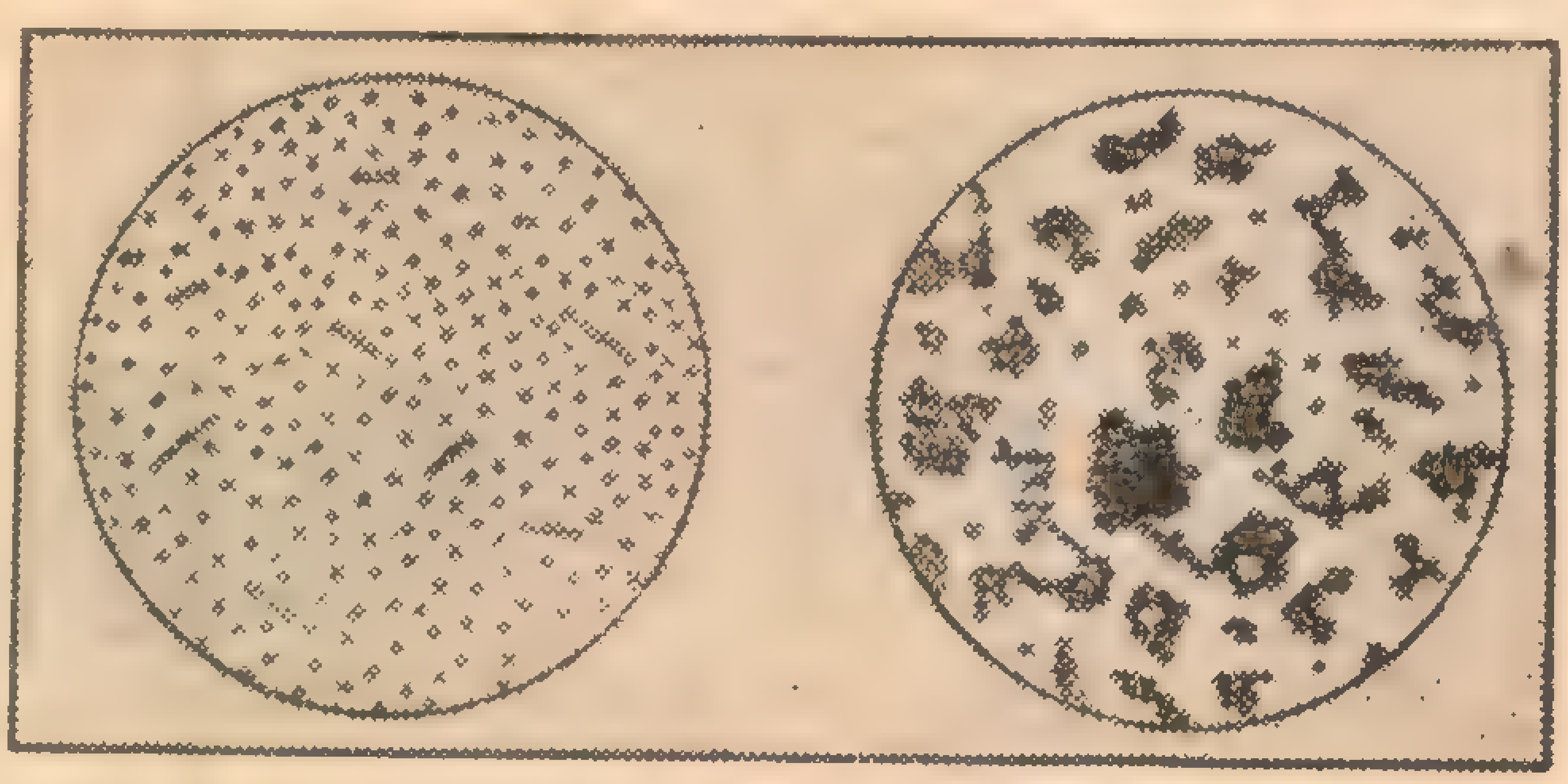
Of course, it is important to first make sure that the donor is not suffering from any disease that is likely to be transmitted to the patient.

Blood transfusion technique has made enormous headway in the last year or two. The most outstanding progress is in the method of drying blood, so that it will keep for an indefinite period. This method has been introduced by the Russians, who also have a method of freezing blood and so preserving it for long periods.

In the diagnosis of various diseases the property of blood which causes the clmping together of the red corpuscles in the presence of certain bacteria is made use of.

This property is called agglutination.

Serum from the blood of a patient suffering from typhoid fever, for instance, will, if mixed with typhoid bacteria, cause the bacteria to form into clumps that can be readily seen with the naked eye.



Care is necessary, before making a transfusion, to see that the blood of the donor matches that of the patient. On the left is a microscopic picture of ordinary blood and, on the right, a specimen of blood which has been clotted by the introduction of a hostile serum.

This reaction will take place with other diseases and is of great and positive value in the diagnosis of these diseases.

Here, again, enormous headway has been made in technique, and this method of diagnosis has removed the uncertainty of ordinary symptomatic diagnosis used in the past.

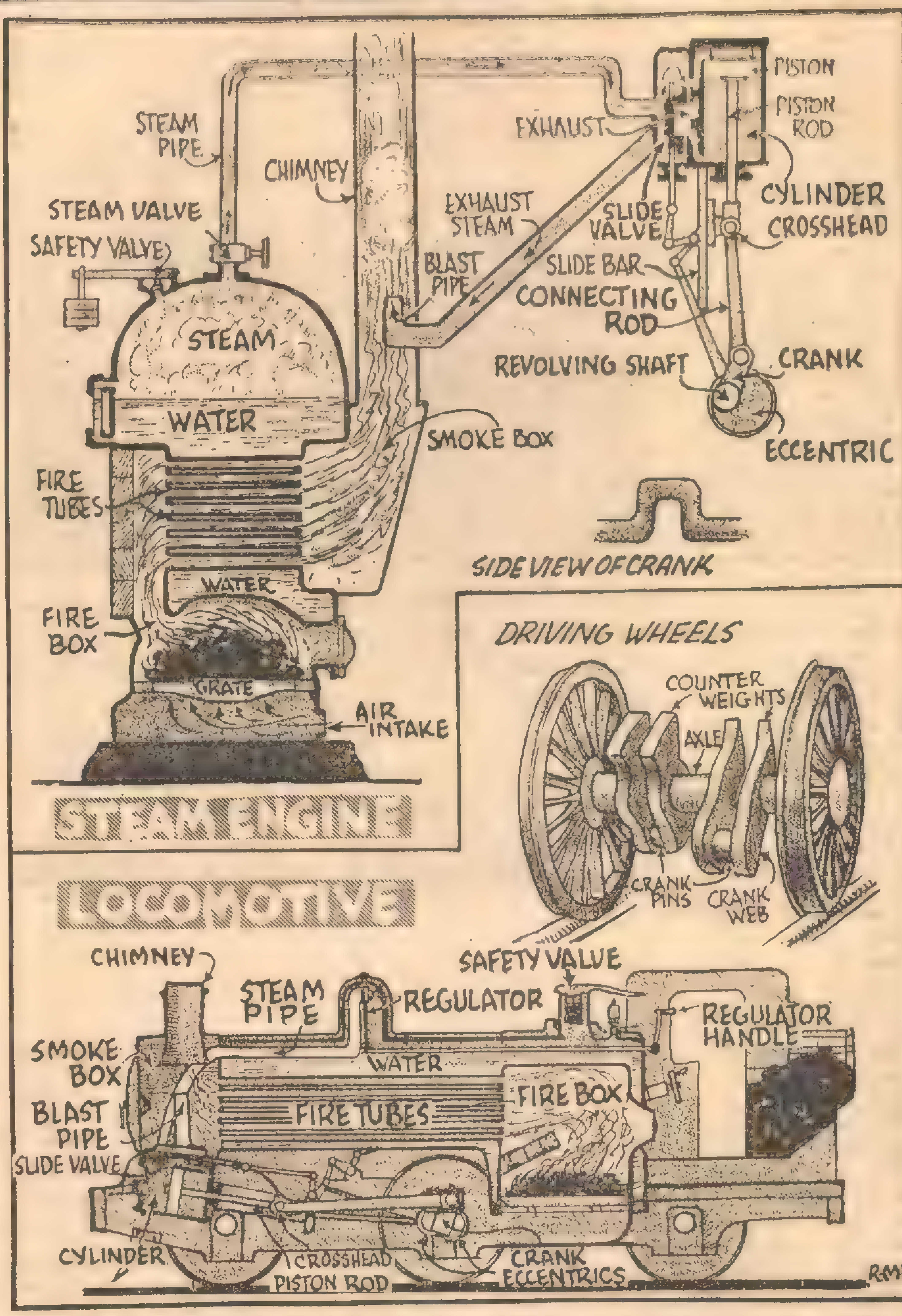
The plasma of blood is a very complex solution. Food products on the way to be used in the various parts of the body and waste materials that go to the various organs for removal and destruction are contained in the plasma.

If a cut is inflicted on or in any part of the body, the plasma comes to our aid and provides a substance which becomes fibrous. This fibrous matter entangles the corpuscles of the blood and prevents the bleeding, which, if left unchecked, might prove fatal.

"HOW IT WORKS"—BY R. M. YOUNGER

THE STEAM ENGINE

It is almost impossible to imagine a world without steam—that giant power that "makes the wheels go round" and drives the machines which give us nearly everything we wear and use—which help to make much of what we eat.



THE steam engine did not come into being through any one single worker, but was the result of work and development by men over a long period.

Modern steam engines are of two kinds, reciprocating and rotary. The former employs cylinders, cranks, and flywheels, while the latter are in a class by themselves. The former class includes ordinary locomotives, donkey engines, steam rollers, and similar machines, and works according to the principle illustrated in the top part of the sketch.

Starting at the base of the diagram of the steam engine, we see that the coal is burning brightly, releasing energy in the form of heat. Over the firebox is a boiler containing water, and, in order that the fire can play on as much water as possible, it is drawn through a large number of fire-tubes, which are really surrounded by water.

HIGH STEAM PRESSURE

As the water boils, steam from it collects at the top of the boiler. Since water increases in bulk over 1700 times on becoming steam, the pressure of the steam soon goes up. To prevent explosion, a safety-valve is provided through which the steam can force a way out when it is in excess of a certain pressure.

The engine begins to function when the steam valve is opened. Steam then passes along the steam pipe to the slide valve, over the top, and into the cylinder. Expanding in the cylinder, the steam forces the piston downward, the movement being transmitted by the piston rod to the connecting rod and crank. The latter converts the up and down movement into a rotary movement, causing the crankshaft and flywheel to revolve.

In turning, this crank drives another —the "eccentric"—with it, in turn moving the slide valve up, so that finally the steam's path to the top of the cylinder is closed. At the same time the passage from the cylinder to the exhaust pipe is opened, and the steam can then make its way to the blast pipe in the chimney, where it "puffs" and helps to draw the fire by creating a strong upward draught.

DOUBLE ACTION

Now, as the slide valve moves up it opens another hole from the steam pipe—this time the one to the bottom of the cylinder. Here the pressure of the steam carries the piston up, keeping the crank turning and the eccentric moving. At the end of the stroke the valve comes down, opening the bottom of the cylinder to the exhaust—as shown in the diagram—and opening again the passage to the top of the cylinder for the boiler steam.

Thus the process is continually being repeated, and the revolving shaft is kept in motion.

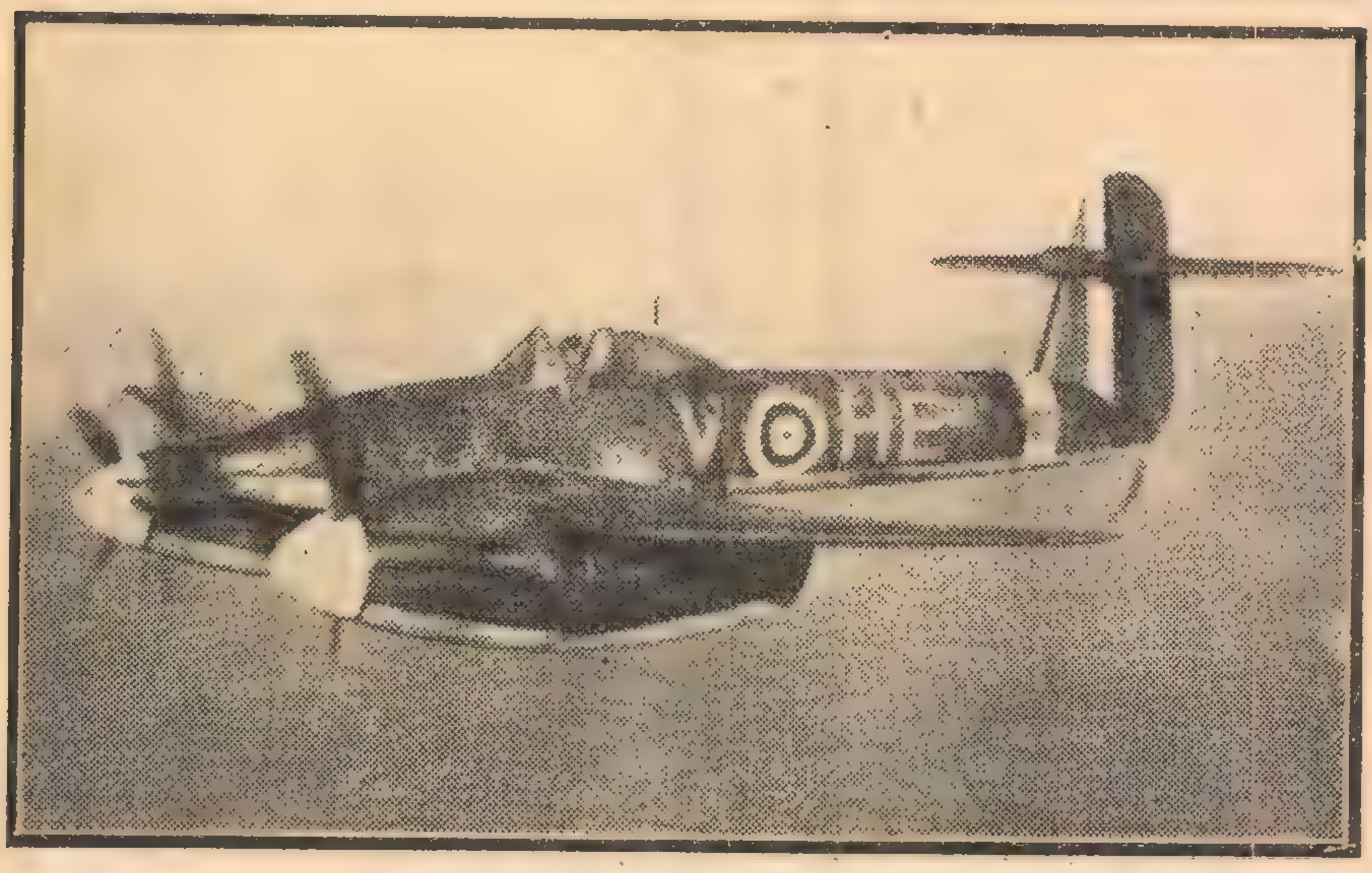
This engine is of the double-acting type. In the single-acting variety, steam is admitted only on one side of the piston, and the power for the return stroke comes from the downward thrust of a second cylinder.

The slide-valve illustrated—known, because of its shape, as the "D" type—is of simple form. In actual practice a valve of this type would be modified to overcome certain defects in working. There are some difficulties with it, due to friction, and now another type is widely issued.

This is the piston, or cylindrical, valve. Its principle is the same: it consists of a spindle carrying two small pistons that

(Continued on Page 43.)

THE "WHIRLWIND" AND THE "SKYROCKET"



Britain's Westland "Whirlwind" in flight. Note the sleek motor nacelles and fuselage and the "cruciform" tail structure. Note also the excellent visibility which the pilot has in all directions. This plane combines effective armament with long range and a top speed of something over 350 mph.

A recent trend has been to design bombers capable of flying over the 30,000ft. mark; the result has been to change the design of fighters quite considerably. New fighters, coming into production or just rolling off the production line, have to be capable of terrific upward climbs and of speeds in excess of 400 mph in order to intercept the modern bombers, many of which are capable of flying at over 350 mph.

BY way of example, the Martin B26 bomber, known as the "Marauder," is capable of a very high speed, even with full load. Pilots refer to them as the "aerodynamic honey" and tell how that, on many occasions, they have simply outpaced Japanese fighters seeking to intercept them.

In order to obtain the necessary speed and rate of climb, it has become necessary to design fighters which are, practically speaking, all engine. New engines are constantly being tested and designed. Engines of over 2000 hp (the Curtiss Wright "Duplex" is of 2400 hp) are being used in the newest high altitude fighters, such as the P47, otherwise known as the "Thunderbolt," and produced by the Republic Corporation.

TWIN-ENGINED FIGHTERS

Considerable attention has been given to twin-engined fighters carrying heavy armament. One of these—the P38 "Lightning"—has been in action for some time, both with the RAF and US Army Air Force. However, until recently, little or nothing had been released on more recent twin-engined planes, such as the Westland "Whirlwind" and the Grumman "Skyrocket," both of which are twin-engined with single fuselages and fins.

At first, many thought that they would be somewhat similar to the "Beaufighter" in looks and armament, but silhouettes and photographs now reveal that they are quite different, both from the "Beaufighter" and the "Lightning."

The "Whirlwind" is a British fighter designed just prior to the outbreak of war. For some considerable time tests have been carried out to eliminate some of the "bugs" which were associated with this queer-looking and certainly revolutionary fighter.

Now, however, the Westland "Whirlwind" is definitely in squadron service in large numbers, and many of these "Whirlwind" squadrons have seen action over Europe in the terrific daylight raids being carried out by the RAF. It has been used as a night fighter with excellent results; it has escorted bombers at night over Europe and has been employed for home defence.

by John French

The streamlining of the "Whirlwind" is as near to perfect as is possible, having regard to military necessities, such as armament and width of vision.

Even the junction of the fin and tailplane is built up to avoid interference of the airflow and controls. This streamlining adds even more to the machine's queer appearance, and the high fin with the tailplane fixed into it about half-way up is an excellent recognition feature. This type of tailplane has been given the name of "cruciform."

Recently published photographs, taken from almost every angle, show amazing manoeuvrability and rate of climb. They also reveal flaps of the Fowler type, and show that the rear ends of the engine nacelles are hinged in such a manner as to move downwards with the flaps.

Two 860-hp Rolls Royce Peregrine engines provide the power to drive two constant speed De Havilland airscrews of the cam-bracket three-bladed type of diameter 10ft. Pitch may be varied within a range of 20 degrees.

The engines give a very sleek appearance, their radiators being totally enclosed in the wing. The ducts in the leading edge between the fuselage and engines allow for the passage of cooling air to the engines themselves. For night work, muffs are fitted to damp the exhaust flames, thus making it extremely hard to see.

RETRACTABLE LIGHTS

For night work also, large landing lights are fitted and are retracted into each wing. It may be of interest to note that the engines used have the same cubic displacement as that of the Kestrel type, used in the old Hawker "Demon," which still flies in Australian skies. However, power output and rpm are much higher than in the Kestrel and the motor is fully supercharged.

Following the usual Rolls Royce practice, this engine is a 12-cylinder Vee engine with liquid cooling. The two banks of cylinders are set at 60 degrees to each other. Power output at 3000 rpm at 3000ft. is 885 hp.

The landing gear, including the tail wheel, is fully retractable, thus adding to the streamlining. Looking from the front, this fighter presents an extremely small target area.

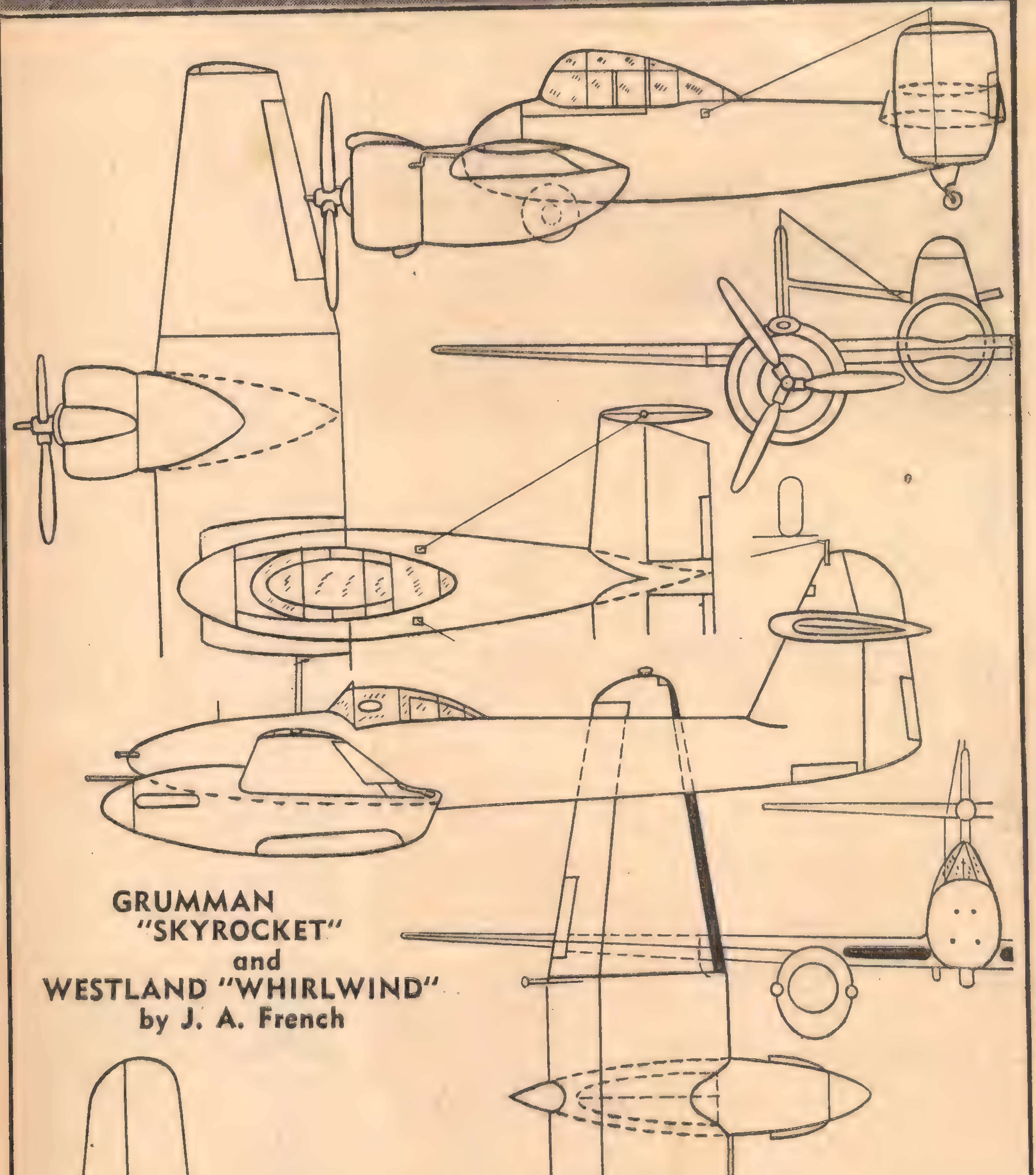
ARMAMENT

Notice that the engines are of greater cross-section than the fuselage. Visibility from the pilot's cockpit is excellent in every direction, far better, in fact, than that in most modern fighters.

Armament consists of four 20mm. Hispano cannons, situated in the nose of

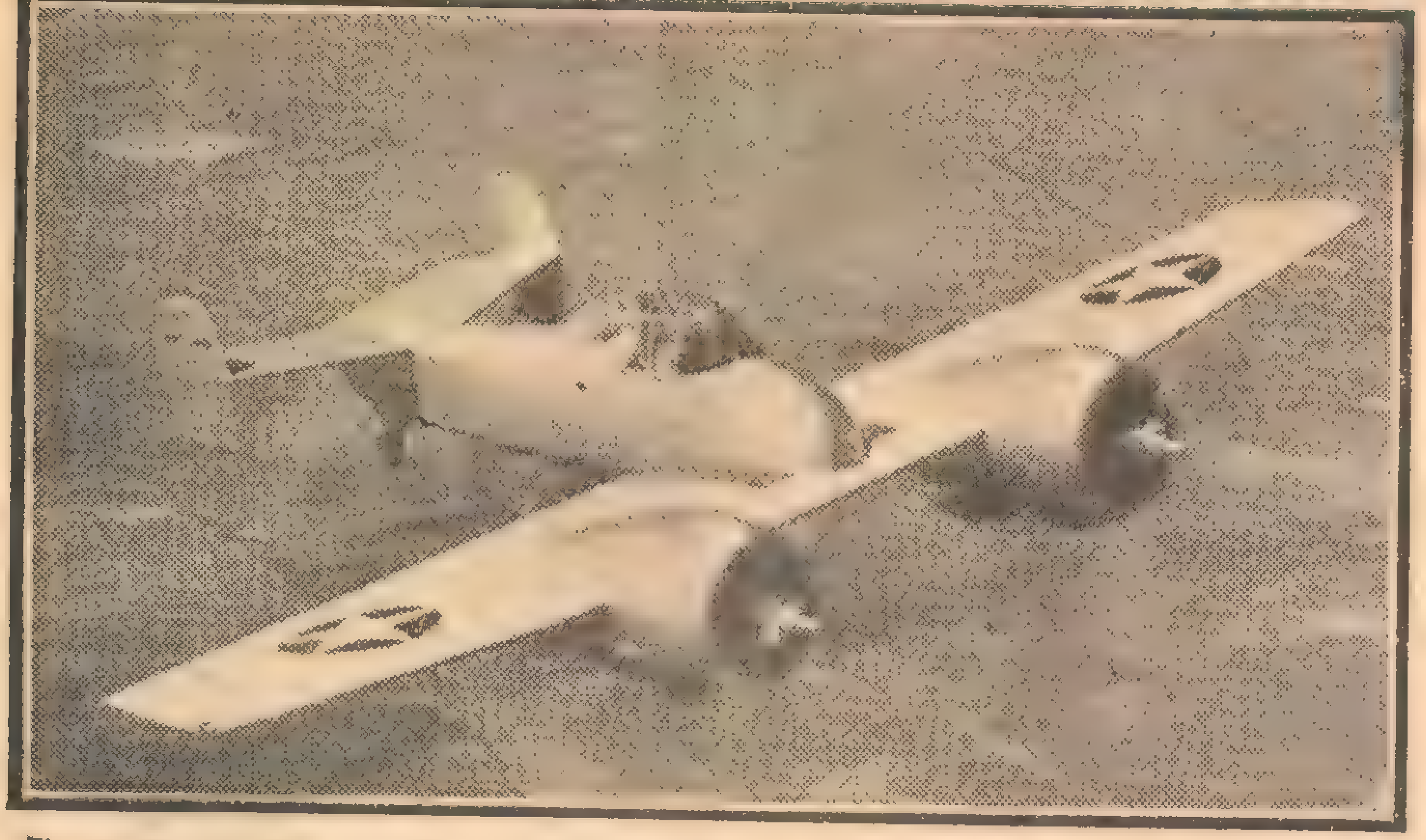
(Continued on Page 14)

TWIN-ENGINED TERRORS OF THE SKY



GRUMMAN "SKYROCKET" and WESTLAND "WHIRLWIND" by J. A. French

THE TWIN-ENGINED GRUMMAN "SKYROCKET"



The Grumman "Skyrocket" twin-engined fighter. Note the very short fuselage, the dihedraled tail unit and the twin fins and rudders. The version pictured above is intended for use by the US Navy and is fitted with radial motors. It is suggested that the army version will be fitted with in-line Allison motors increasing the speed from 425 to something like 450 mph.

the fuselage and protruding in pairs to the extent of about 2ft. 6in. and 1ft. respectively. This armament would make these machines excellent for ground strafing and as tank destroyers, and probably much more will be heard of them.

German sources give the maximum speed as 353 mph at 16,350ft., and it appeared in their recognition books almost a year ago.

Wing span is 45ft.; length (overall) 31ft. 6in.; length (fuselage), 30ft.; height, 11ft. 7in.

THE "SKYROCKET"

Unorthodox design is expected from America, and certainly the Grumman XFSF—1, or "Skyrocket," as it has been named, does not differ from the rule. It is a US Navy pursuit ship designed during the present war. The general layout rather gives the impression that much too powerful motors have been fitted and have wrenched themselves and the wing nearly away from the fuselage, the latter just managing to hang on by the stressed "skin of its teeth."

The simple fuselage, square-tipped wings, and tail unit will lend themselves to mass production if the plane is ultimately accepted by the British Purchasing Commission or the US Army or Navy Board. Only a short while would elapse before numbers of this craft are in service. No confirmation can be found for the rumor that a number are on order for the Fleet Air Arm.

Both Army and Navy are interested in the prototype, which is still being tested. The naval version is powered by two fourteen-cylinder Wright Double-Row Cyclone air-cooled radial motors developing in the vicinity of 1800 hp. The Army version is being fitted with in-line Allison engines and will soon be undergoing tests.

The "Skyrocket" is quite a small craft, with a span of 42ft. (2ft. smaller than a "Hurricane," or 3in. smaller than a "Whirlwind"). It is 28ft. 6in. long. It is thus the smallest two-motored fighter now flying. Loaded weight is 7682lb., of which something over 1000lb. is disposable.

METAL CONSTRUCTION

The machine is of all metal construction, the wing being built up on two spars in three sections. It is stressed skin-covered, as is the fuselage. Ailerons are fabric covered.

The tail unit is dihedraled and has twin fins situated on the end of the tailplane; elevators and rudder control sections are fabric covered. The undercarriage is fully retractable, but the tail-wheel is of the fixed variety.

Armament consists of two shell-firing cannon guns, probably of the 27mm. or 37mm. variety, and six machine-guns of .5 calibre, mounted either all in the nose or with the machine-guns in the outer wing sections, firing outside the airscrew.

Reported climbing capabilities and speed are interesting. The naval radial-engines version is reported to exceed 425 mph on level flights at over 20,000ft., which means that the estimated top speed of the Army product would near the 450 mark.

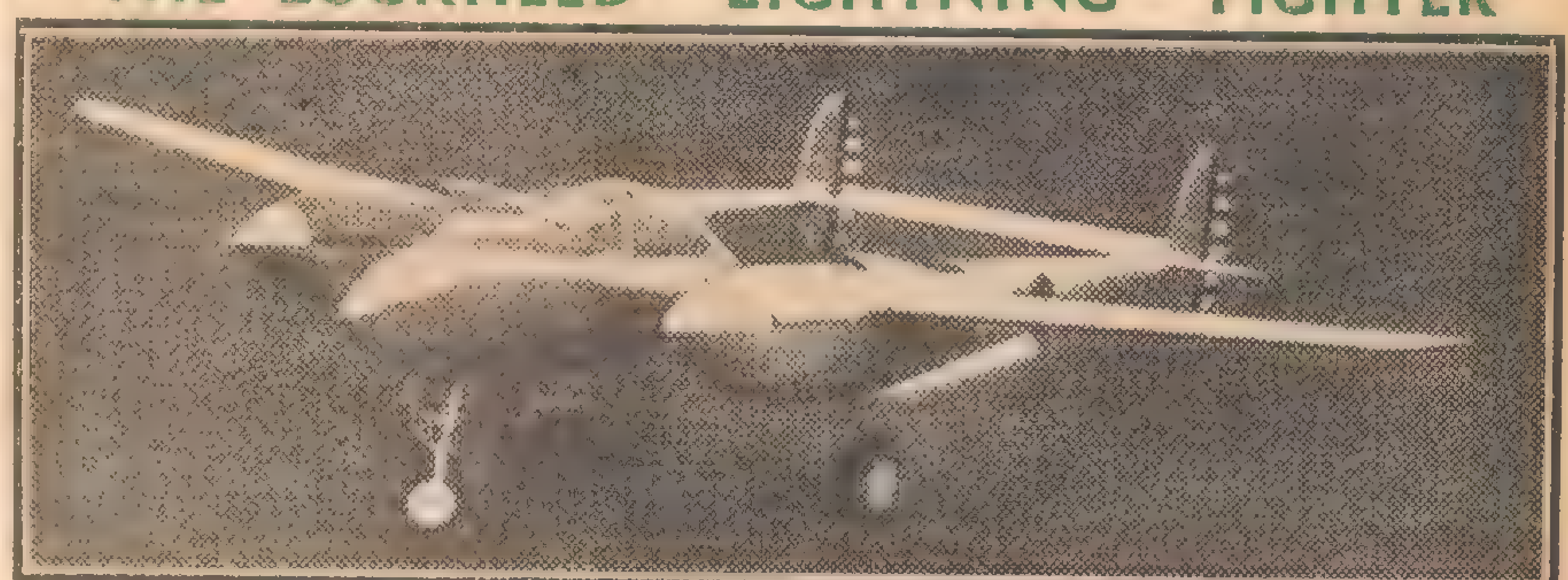
RATE OF CLIMB

Rate of climb is reported to be in access of 6000ft. per minute, or 60 mph straight up, which is faster than anything yet built in the world. Interception will be easy if the craft is accepted for service, although, like the "Whirlwind," teething troubles are being experienced. This is no doubt due largely to the incredibly high horse-power of the engines being put in such a small craft.

Landing speed is reported to be only 70 mph, which, if true, is an extremely low figure for a craft of this speed. Large flaps are fitted, however, and this may account for the slow landing speed.

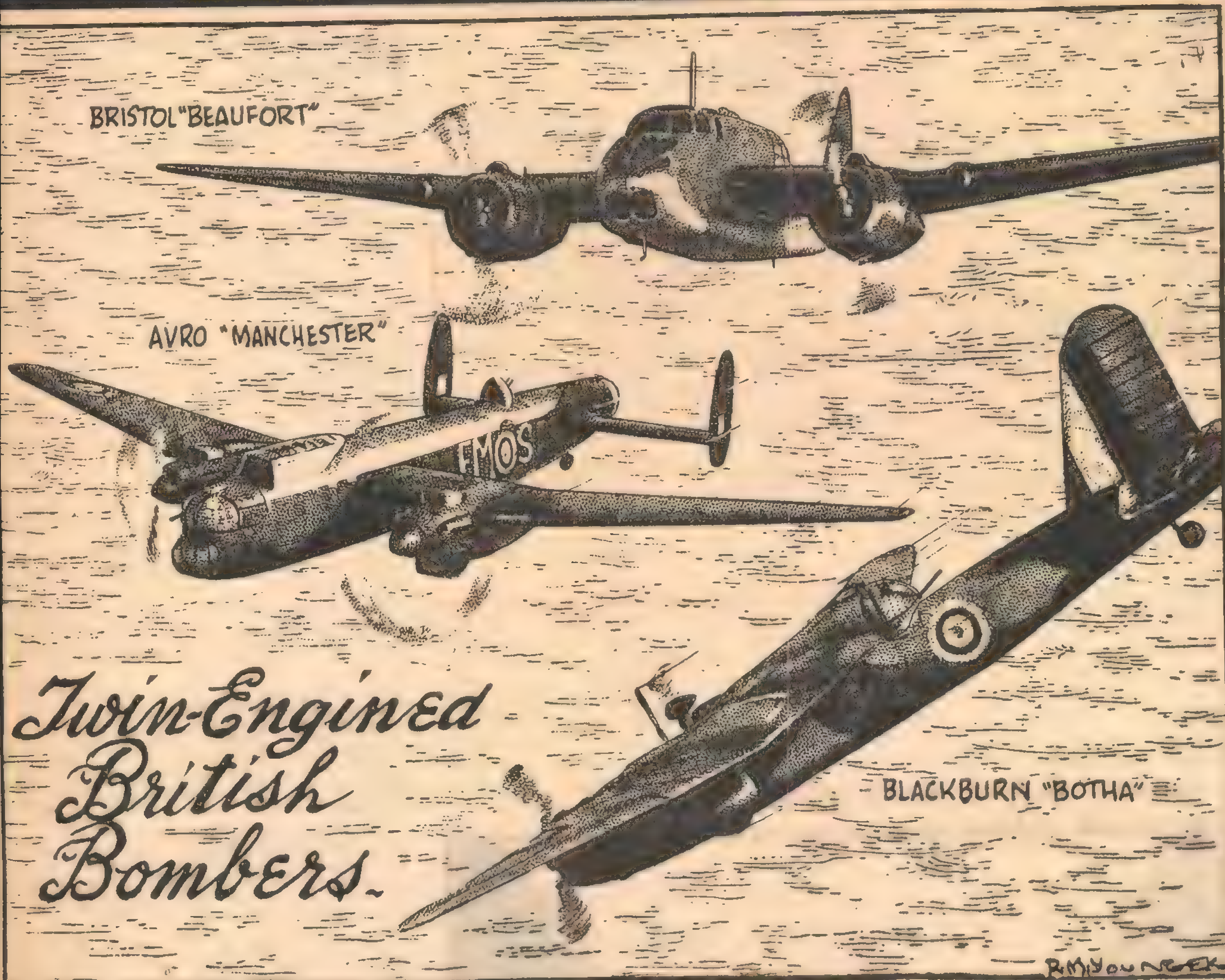
Experts will watch with interest the service careers of the "Whirlwind" and "Skyrocket," and their success or failure will probably influence future fighter plane designs.

THE LOCKHEED "LIGHTNING" FIGHTER



It is interesting to compare the "Whirlwind" and the "Skyrocket" with the Lockheed "Lightning." Main point of difference is in the twin booms, extending from the motor nacelles to the tail unit. As yet, very little has been said regarding the performance of the "Lightning" under service conditions.

GIVING THE LIE TO GOERING'S BOAST



Three of Britain's newer types of twin-engined bombers are shown in the sketch above. These are some of the planes which are now smashing Axis objectives in the RAF's colossal thousand-bomber raids.

SHOWN at the top is the Bristol "Beaufort," which is well known in Australia, as this type is in production here, and is in RAAF squadrons. As in the RAF in Britain and overseas, it has proved itself a formidable weapon.

A fast reconnaissance bomber, the Beaufort has a top speed of over 300 mph. It is powered by twin 1060-horsepower radial, sleeve-valve motors with three-blade constant-speed airscrews. The deep fuselage has a curved, transparent nose. The sections of the undercarriage retract into the engine nacelles, and the tail-wheel also retracts.

A crew of four is carried. As well as forward-firing machine-guns, there is a turret on top of the fuselage just behind the wings. The tail unit is composed of a single fin and rudder.

At centre left is shown the new twin-engined giant, the Avro "Manchester." This is the largest twin-engined bomber in the world, and only the powerful new engines made it possible.

Manufactured by the long-established A. V. Roe and Co., the Manchester is a mid-wing monoplane of all metal construction. The model sketched is the later form, with large twin rudders. An earlier version had also a central fin.

The machine is heavily armed and armored. The front turret is believed to have two machine-guns. The rear turret, set between the widely-placed rudders, has four guns, and the "egg" shaped turret at the top of the fuselage probably has two more. The bomb-load is carried in a large section which is near the centre of gravity (to help manoeuvreability).

The wing roots house self-sealing fuel tanks. Fuel-jettisoning gear is carried —a retractable, flexible pipe which reaches below the wing when it is lowered.

R-R "VULTURE" ENGINES

Power is from two of the new Rolls-Royce "Vulture" engines of 24 cylinders rated at over 1750 horsepower each. The machine can maintain height on one motor.

With a wingspan of 90 feet and a length of 70 feet, the machine is built to dimensions almost equal to the four-engined Halifaxes and Stirlins.

The Manchesters have been used for night raids; hence they are colored

(Continued on Page 55)

ITEMS OF NEWS FROM A WORLD AT WAR

Grumman "Avenger" Torpedo Plane.

THE US Navy has permitted the Grumman Aircraft Corporation to release details of a new Avenger torpedo-plane which has been in mass production for several months.

The plane was used for the first time in the Midway battle, in which it proved most successful.

It is the only plane in the world carrying its torpedoes entirely enclosed within the fuselage, thus increasing the surprise element.

Its cruising range is 1400 miles, its ceiling 20,000 feet, its speed over 270 miles an hour. It carries a 2000lb. torpedo load, has high manoeuverability, is heavily armed, and is one of the largest planes operating from a carrier.

* * *

Giant Propellers

CURTIS Wright, aircraft designers and makers, have developed a giant propeller for a new twin-engined US Navy flying-boat.

The propeller, largest of any in use, is bigger than that being used for the new Army 82-ton bomber and the huge Mars flying-boat.

The new propeller will also be installed in high-flying bombers and cargo planes. "It is especially suitable for high altitudes and low density flying.

Curtis "Goshawk" Fighter

A NEW American Curtis fighter, successor to the Tomahawk and Kittyhawk, is now coming off the production lines in quantity. Armed with twelve machine-guns, it is credited with a speed of nearly 400 mph. The machine is expected to be called the Goshawk.

Officially known as the Curtiss P-40 F, the machine is a single-seater powered by a 1300-hp Rolls-Royce Packard Merlin engine. It has a ceiling of nearly 11 miles, making it suitable for combating stratosphere bombers, and incorporates several revolutionary ideas.

NEW SECRET WEAPON?

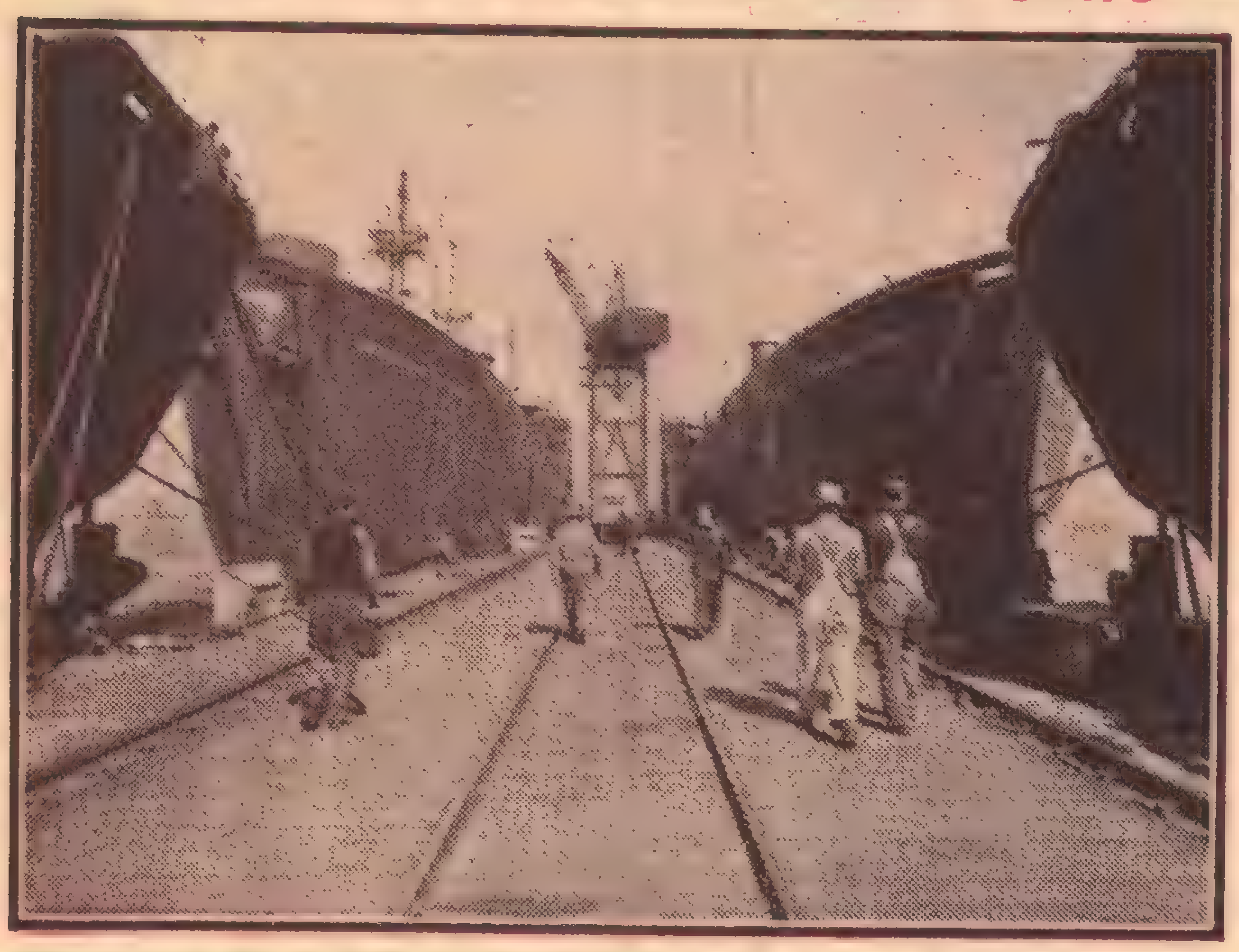
A MILITARY secret may win the war for the Allies before 1943.

This prediction was made in Washington recently by the Chairman of the House Military Committee (Mr. May).

He went on to say that "the war will probably end in 1942, unquestionably in 1943. I base this statement on a military secret, obtained since the apparent Russian reverses."

Let us hope that you are right, Mr. May!

SHIPS, SHIPS AND STILL MORE SHIPS



It is no secret that the Allies are desperately in need of ships not only for successful defence but to enable them to take the offensive. American shipyards are breaking all records—a tanker delivered within 100 days of the laying of the keel—a destroyer launched within 60 days—battleships one year ahead of schedule. Our picture shows four "Liberty" freighters lined up at the Bethlehem shipyards and rapidly being made ready for the sea.

Rocket Trap For Bombers

BRITISH ships are successfully fighting bombers with a rocket device which shoots parachutes with long wires attached.

This is similar to the German aerial mine, first reported in use last May.

"The British device is one of the most successful developed in the war at sea," according to an official statement.

"It is a rocket apparatus which shoots parachutes into the sky. If the swooping enemy bomber does not swerve sharply off its aim it gets entangled.

"German pilots fear these rockets, which force them to drop bombs wide of the ship they aim at."

* * *

New Patrol Boat

UNITED States boatbuilders have evolved a revolutionary type of patrol boat which the US Navy will build and test for use in the war against Axis submarines.

After a conference with US Navy officials, boatbuilders said they could build 3000 of the new boats at short notice.

The US Navy Department announces that a new light diesel engine and a variable pitch marine propeller are now in full mass production.

"The new engine is a tremendous step forward in the fight against submarines.

"The engine is believed to be the lightest for ocean duty yet designed. It takes up a third of the space taken by the best older type engines of the same horse-power.

"The propeller is reversible, so that the engine does not require reversing, thus obviating reverse gears."

* * *

Locating Bomb Fragments

A "MAGNETIC finger" that locates tiny fragments of bombs and shells in the human body with uncanny accuracy is likely to be adopted for use by the Medical Corps of the armed forces.

The "finger," which was invented by Samuel Berman, an engineer employed by the Independent Subway System, has been tested at the Post-Graduate Hospital.

Pinhead fragments can be found at a depth of a quarter of an inch.

When the "finger" approaches hidden metal an indicator reacts.

* * *

Steam Driven Planes

STEAM-DRIVEN aircraft of exceptionally high power are being experimented with in Germany. They are designed for high altitude flying. The Nazis have also produced new and bigger gliders, some with light motors to assist landing.

Launching Device For Nazi Fighters

IT is reported that the Luftwaffe is using a new rocket launching device for fighters, as part of the defence against RAF sweeps across the Channel. German newspapers say that the device can throw a fighter to a height of several thousand feet at a speed of nearly 400 mph. By means of this quick take-off, defending planes might be able to gain an advantage in height before our bombers and fighters arrive.

* * *

Fifty-ton Tanks

FIFTY-TON Voroshilov tanks are being used by the Russians and prisoners say their appearance terrified the German infantry.

"All we hear are slight thuds, with very little shock," said a Russian who fought in a Voroshilov tank. These ironclads, he added, rarely catch fire, even if an incendiary bottle is dropped over the motor casing. They have armor several inches thick and fire a three-inch gun and four machine-guns.

* * *

Submarine Freighters

US Senator Lester Hill has urged immediate construction of 7500-ton submarines to carry American war material to the various fronts.

Largest combat submarines afloat are in the 2000-ton category, but Hill argues that 7500-tonners are the only answer to Germany's U-boat campaign.

He says he offered the idea to the Navy Secretary, Col. Knox, and was told such submarines were feasible if shortage of materials was disregarded.

* * *

Nazis Building Midget Subs

GERMANY is building small submarines, of the Japanese midget type, for transport down the Danube to the Black Sea, says the "Evening Standard" diplomatic correspondent.

"These submarines are part of a plan for demolishing the Russian Black Sea Fleet.

"The submarines are being built at Linz (Austria). They are designed to operate with a crew of three or five.

"The Germans also plan mass attacks against the Russian Fleet with Luftwaffe units, operating from the Crimea and the Danube delta."

* * *

Another Rubber Plant

THE Mexican plant, cryptostegia, which grows freely over wide areas, might answer the rubber shortage, declared a "Daily News" special reporter who recently investigated cryptostegia fields. He says some Washington officials are now aware of the potentialities and urge a full test.

A process has been discovered in the United States by which synthetic rubber can be made from agricultural products. Experts who evolved the process estimate that 120,000,000 bushels of corn or wheat would produce 600,000 tons of rubber—normal annual consumption of the United States.

THE GRENADIER GUARDS IN NEW GUISE

The Grenadier Guards, famous the world over, have exchanged any glamor and color that may have been theirs for the grim realities of a world war. Gone are their prancing horses; in their place are speedy motorcycles, mounting deadly Tommy guns. The British Army is rapidly achieving complete mechanisation.

Rejuvenate For Victory

REJUVENATION of men and women past 60, to enable them to do war work, is urged in an article in the journal of the American Medical Association.

Scientist V. Korenchevsky suggests injection of vitamins and hormones from adrenal, thyroid and sex glands.

"Such treatment will banish narrowing of interest, conservatism, and lack of imagination and inventiveness which characterise senility," Korenchevsky says.

"Sex hormone treatment should stop short of rejuvenation of romantic interest, which is not desirable in old age."

R. R. DAVIS DESIGNS A SUPER-FIGHTER

MR. R. R. DAVIS, the American inventor of the "Davis Wing," used on Liberator bombers, is stated to have designed a new fighter aeroplane, with a top speed of 455 mph, and a range that could take it easily from Britain to Berlin and back. The fighter, models of which have just completed two years of wind-tunnel tests, will, if the design proves successful, have a flying time of 10 hours and a range of about 2500 miles, and will be equipped with four shell-firing cannon and four machine guns. Present plans are that this machine will be constructed of steel and plastic-bonded ply-wood, and will be fitted with an engine of at least 1500 hp.

Wheat Fuel For Cars

A REPORT by a technical officer of the Supply Department does not favor the use of wheat as fuel in gas producers at present. Further tests will be made, however, because of local shortages of charcoal and the surplus of wheat.

"Tests indicated that 3lb. of wheat would replace 2lb. of charcoal. The retail price of wheat is approximately 1d a lb., and the retail price of charcoal varies from 1d to 1½d a lb.

* * *

Synthetic Kapok

A FACTORY has been opened in Petoskey (Michigan) to process milkweed floss as a substitute for kapok in lifebelts and as lining for flying suits.

Experiments indicate that the floss will be warmer than wool. It is six times lighter and six times more buoyant than cork.

The US Navy will obtain the floss from milkweed pods in 50,000 acres of wild lands in northern Michigan.

* * *

Rare Operation Saves Twin's Life

A RARE operation is expected to save the life of Evelyn Salcedo, one of twin girls born prematurely.

The doctors found that Eve was unable to take food because the oesophagus tube leading to the stomach ended in a blind passage.

A doctor operated, making it possible to feed the baby externally by drops.

Later another operation will be performed to provide the child with normal digestive organs.

The other twin is normal.

WE DO OUR BEST . . . . .

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However, you may rely upon us to speed up the delivery of your instrument and thank you in advance for your co-operation and understanding.

As you know, the needs of the men in uniform must come first.

Therefore, the instruments we can supply for civil requirements are as a trickle compared to the flood of "University" meters and test equipment being delivered to the Fighting Forces.

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An illustrated brochure describing "University" test equipment is available free upon request.

1.

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3. Fitting tiny meter parts is a job only for sensitive fingers. All Radio Equipment employees are specially selected and trained for all phases of meter and test equipment work.

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BUILD UP A SHORT-WAVE CONVERTER

To judge by the letters we receive, there must be quite a large number of our newer readers who are interested in short-wave reception, but who are not fortunate enough to possess a receiver capable of tuning on the short-wave bands.

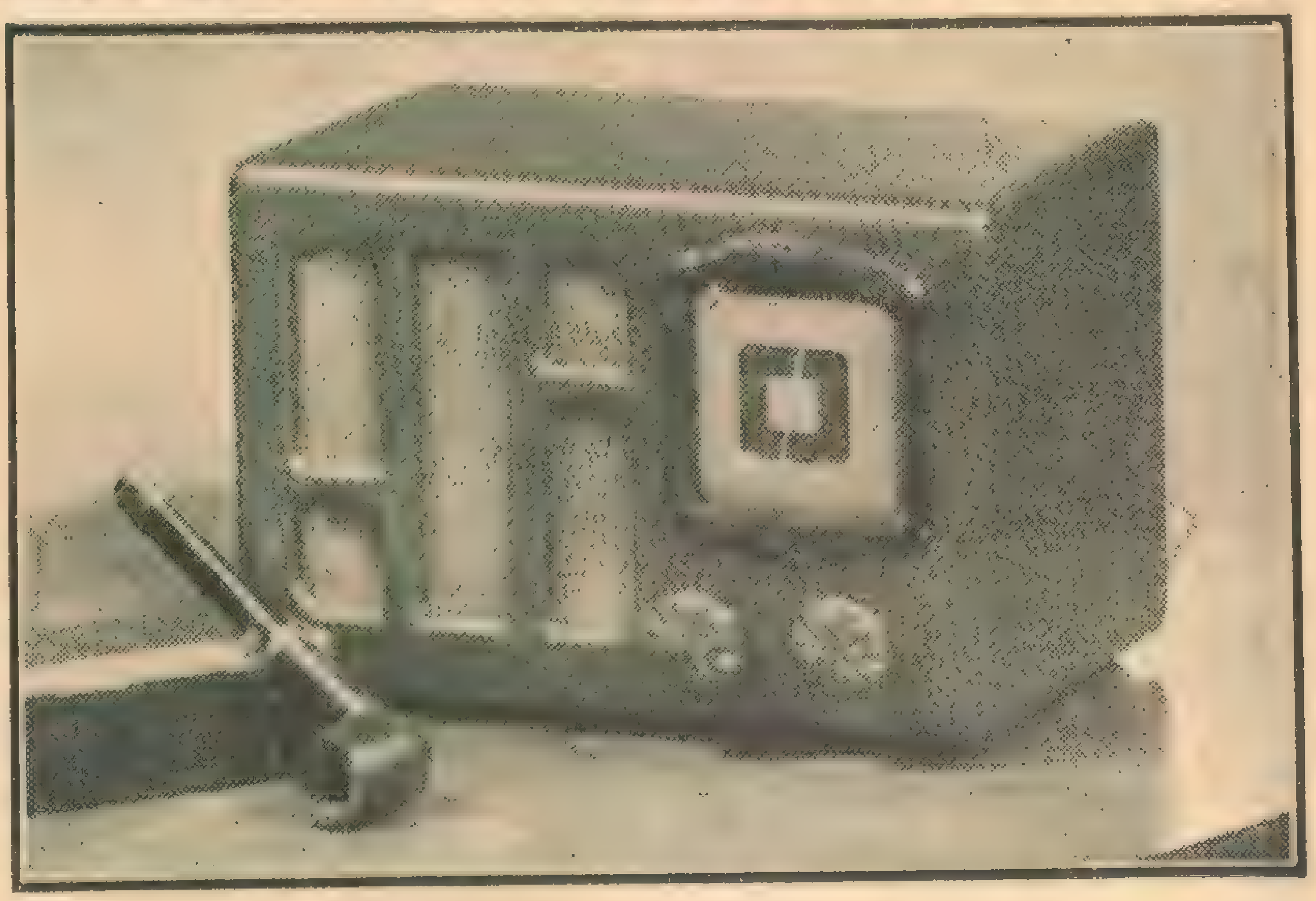

Figure 1. Housed in a cabinet such as that designed for the "Little General" receiver, a short-wave converter will not look out of place alongside or atop any console. "Little General" cabinets are inexpensive to buy and readily obtainable. The dial glass should preferably be of the type calibrated 0-100. There will be nothing behind the speaker grille, but no one will be any the wiser, looking from the front.

ALTHOUGH the most convenient measure is undoubtedly to buy or build a good dual-wave receiver, quite a lot of fun can be had, with less expense, by building up a short-wave converter for use with the existing broadcast receiver.

It is quite a long time since a short-wave converter was described in these pages. The particular issues have long been out of print, and we have been unable to help those interested in the subject as much as we would have liked.

In the following pages we present three different designs in ascending order of price, complexity, and performance. Even if you are not interested in the constructional aspect, you may be interested to study the principles involved.

Quite a lot of our correspondents appear to be confused between short-wave "adaptors" and short-wave "converters." There is quite a difference between the two, both in performance and in the principle of operation.

Short-wave adaptors were in their heyday when 99 per cent. of the domestic receivers in use were of the TRF variety, with regenerative detectors. A short-wave adaptor is in reality a single-valve short-wave tuning unit.

SHORT-WAVE ADAPTORS

The general idea was to take the detector valve out of the broadcast receiver and replace it with a plug, and a lead from the adaptor. The plug picked up the filament and plate voltages from the detector socket and fed them to a corresponding socket in the short-wave adaptor.

The detector valve was then plugged into the adaptor, where, in conjunction with suitable tuning and reaction circuits, it was capable of tuning in short-wave stations.

The "detected" signals were then amplified by whatever audio stages were in the main receiver. R-F stages in the receiver, if any, were simply not utilised. As a general rule, short-wave adaptors of this type were inefficient in operation, and the results were poor.

The principle of the short-wave converter is quite different. The reception is achieved, not by any substitution of tuning circuits, but by utilising the heterodyne principle of reception, exactly as in the familiar "superheterodyne" receivers. Heterodyne reception may be explained as follows:

HETERODYNE RECEPTION

When two voltages of different frequency are mixed, other voltages are produced at frequencies quite different from either of the original frequencies.

These so-called "beat" or "heterodyne" frequencies occur as the sum and the difference of the two original frequencies. As a rule, for heterodyne reception, we are most interested in the "difference" frequency.

by W. N. Williams

In a short-wave converter the short-wave signals are fed from the aerial to a "mixer" stage. The converter also contains an oscillator, which generates a voltage at a frequency determined by the associated tuned circuits. These locally generated oscillations are also fed to the mixer stage.

The output of the mixer stage includes voltages at the frequency of the incoming short-wave signal, at the frequency of the local oscillator and beat frequencies at the sum and difference of the two.

Both "beat" frequencies carry the modulation component of the original short-wave signal. By suitably arranging matters, it is possible to have the "difference" frequency fall within the tuning range of a standard broadcast receiver.

AN EXAMPLE

In case this is not clear, let us take a particular example. Let us say that an overseas station is broadcasting on a wavelength of 20 metres, or a frequency of 15,000 kilocycles per second (kc/s).

If we feed this signal from the aerial to the converter and adjust the local oscillator so that it produces a voltage at 15,600 kc/s, the frequency components in the output of the mixer will be 15,000 kc/s, 15,600 kc/s, 30,600 kc/s, and 600 kc/s, the latter representing the difference in frequency between the two original signal voltages.

If the output of the mixer, containing all these frequency components, were then fed to the aerial terminal of a normal broadcast receiver, all voltages except the last would be rejected, since they fall outside the tuning range of the

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HOW A SHORT-WAVE CONVERTER OPERATES

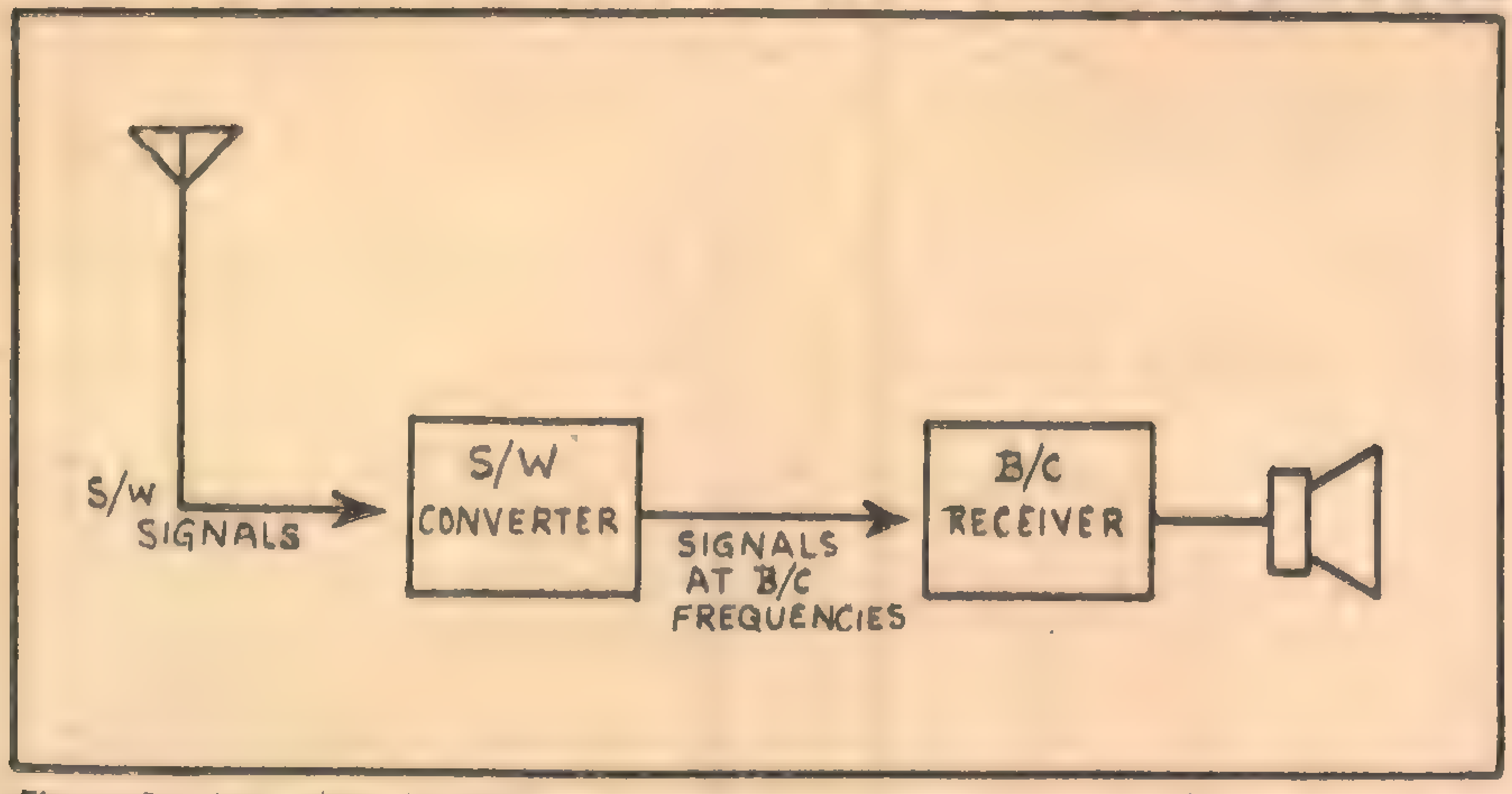

Figure 2. As explained in the text, a short-wave converter is connected between the aerial and the aerial terminal of the broadcast receiver. The converter contains an oscillator, voltages from which beat with the incoming short-wave signal to produce a "beat" signal within the tuning range of the main B/C receiver.

receiver. However, the voltage at 600 kc/s is within the tuning range, and could be picked up by adjusting the receiver dial to the appropriate setting.

As we mentioned previously, this "beat" frequency carries the modulation component of the original short-wave carrier, so that, whatever voice, music, or tone were superimposed on the carrier would be heard through the loud-speaker of the broadcast receiver.

DIFFERENT APPROACH

In actual practice, the problem is approached from the other direction. First of all, the receiver dial is set so that the receiver is responsive to voltages at a certain frequency. It is usual to choose a setting at which there is no very strong broadcast carrier. For the sake of argument, this may be 600 kc/s.

The output of the short-wave converter is coupled to the aerial terminal of the receiver, and the aerial itself fed to the input circuit of the converter.

The tuning control of the converter controls the frequency of the oscillator, so that, as the control is rotated, the frequency of the oscillator output voltage varies.

The signals of the various short-wave stations are being fed to the mixer from the aerial. Whenever the frequency of the oscillator voltage is such that it differs from that of one of the station signals by 600 kc/s, to which the main receiver is tuned, a beat is produced at that frequency, and the signal is heard in the loud-speaker.

The operation is illustrated in the accompanying diagram. Short-wave signals are fed from the aerial to the converter. The signals beat with, or "heterodyne" voltages produced by, an oscillator in the converter itself. As a result of this action, a beat frequency, carrying the modulation component of the original carrier, is produced, the frequency being arranged to fall at a suitable point within the tuning range of the receiver.

FULL GAIN UTILISED

At the receiver this "manufactured" signal is picked up and amplified just like any other signal received directly from the aerial.

It is obvious that the full gain of the broadcast receiver can be utilised, as compared to only the audio gain in the case of a short-wave adaptor.

The converter itself is essentially an attachment, which is coupled in between the aerial and the aerial terminal of the receiver. When it is desired to listen to the normal broadcast stations, the converter is simply disconnected and the aerial transferred to the normal aerial terminal of the receiver.

For the sake of convenience, these changes can be accomplished by switching, so that the movement of a switch either cuts out the converter or brings it into circuit.

The converter may have its own filament and high tension supply, or may derive them from the circuits of the main receiver. This point will be discussed presently in greater detail.

THE B/C RECEIVER

A short-wave converter may be used with almost any receiver which is reasonably selective and which has sufficient sensitivity to bring in interstate stations on the broadcast normal channels. The signal strength from many short-wave stations has so increased during the last few years that it is surprising how easy it is to bring them in.

However, it is not advised to try and use a converter with small one and two valve sets. Short-wave reception may indeed be possible, but the adjustments are likely to be critical and rather "messy."

The broadcast receiver may be either a TRF or a superheterodyne. In either case the frequency transformation takes place in exactly the same manner, the beat frequency signal being picked up and passed on by the tuning circuits.

SUPERHET-RECEIVER

Actually, when the broadcast receiver is a superheterodyne, the desired signal undergoes two complete changes in frequency. In the short-wave converter, the frequency is changed from a very high frequency to one in the normal

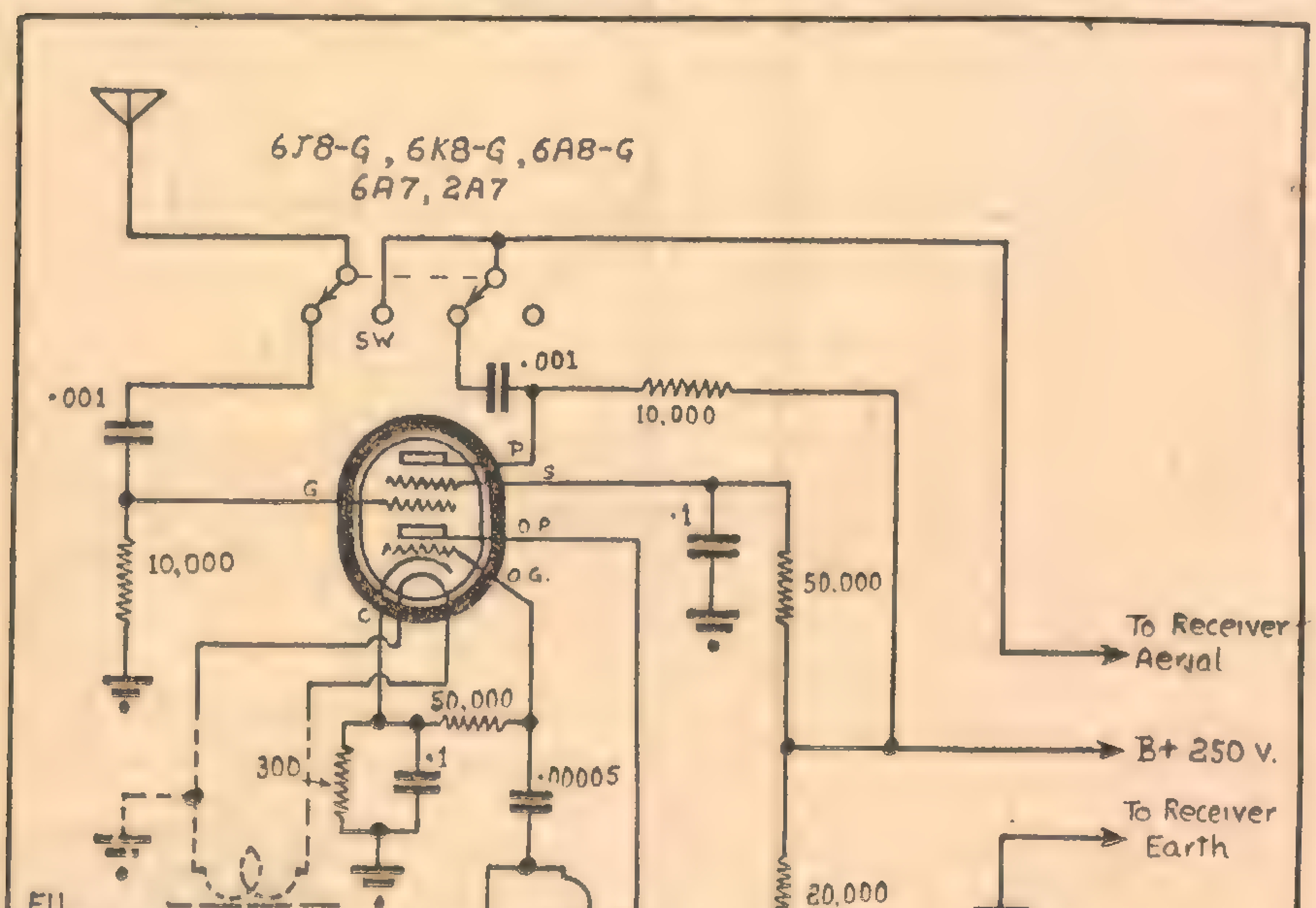

Figure 3. Here is a very simple short-wave converter, which we can call circuit number 1. It uses a single-gang tuning condenser and a home made coil. Any one of the valves listed may be used without change to the circuit. Heater power may be obtained from the filament transformer, as shown, or from the circuits of the main receiver, from which also is derived the high tension supply.

broadcast band; in the receiver; it is again changed by the normal frequency-changer to the particular intermediate frequency used in the receiver. Subsequently it passes the detector, the "carrier" being suppressed and the modulation or audio component isolated for subsequent amplification. One is prompted to say, "Who'd be a short-wave signal?"

Having duly taken this small dose of theory, we can proceed to discuss actual circuits.

THE FIRST CIRCUIT

The first is a very simple and elementary one, which works for all that. Having discussed its operation, we will proceed to point out its shortcomings and to explain the advantages of the more elaborate circuits to follow. The parts used are so ordinary, and it is so easy to build, that almost anyone with a little knowledge of radio should be able to get it into operation.

With a reasonable aerial and earth, it will certainly bring in short-wave stations. If, after building it, you are not satisfied, you will be able to use most of the parts to build one of the more elaborate circuits.

Tracing the circuit out step by step, we see that the aerial is taken to one section of a double-pole double-throw switch. In the position in which the switch is shown, it is connected through a small mica condenser to the signal grid of a frequency converter valve, the grid being returned to earth through a 10,000 ohm resistor. The values of the coupling condenser and of the grid resistor are not at all critical.

VALVE TYPES

The valve may be any one of the types listed on the circuit. There are electrical differences between the types, but, in this case, they are not of sufficient importance to warrant any change in the electrical circuit. In the case of the 6A7 and the 2A7, there is a difference in the base, for which due allowance would have to be made.

Each of the valves is a special type designed for use in superheterodyne receivers and containing an oscillator and a mixer unit in the one envelope.

The grid and plate of the oscillator unit may be identified in the schematic circuit diagram as being the two electrodes nearest the cathode of the valve and connected to the tuned circuit toward the bottom of the diagram.

The characteristics of this tuned circuit determine the frequency of the voltage generated by the oscillator section. Tuning is accomplished by rotating the .0004 mfd. variable condenser.

The output voltage of the oscillator is mixed electronically within the valve with the signals being fed in from the aerial to the signal grid. The "beat" frequences appear in the plate circuit, and are fed through the .001 mfd. coupling condenser and the switch to the output lead. This lead connects to the aerial terminal of the broadcast receiver.

It will be noted that the plate is

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WIRING DIAGRAM OF THE SIMPLE CONVERTER

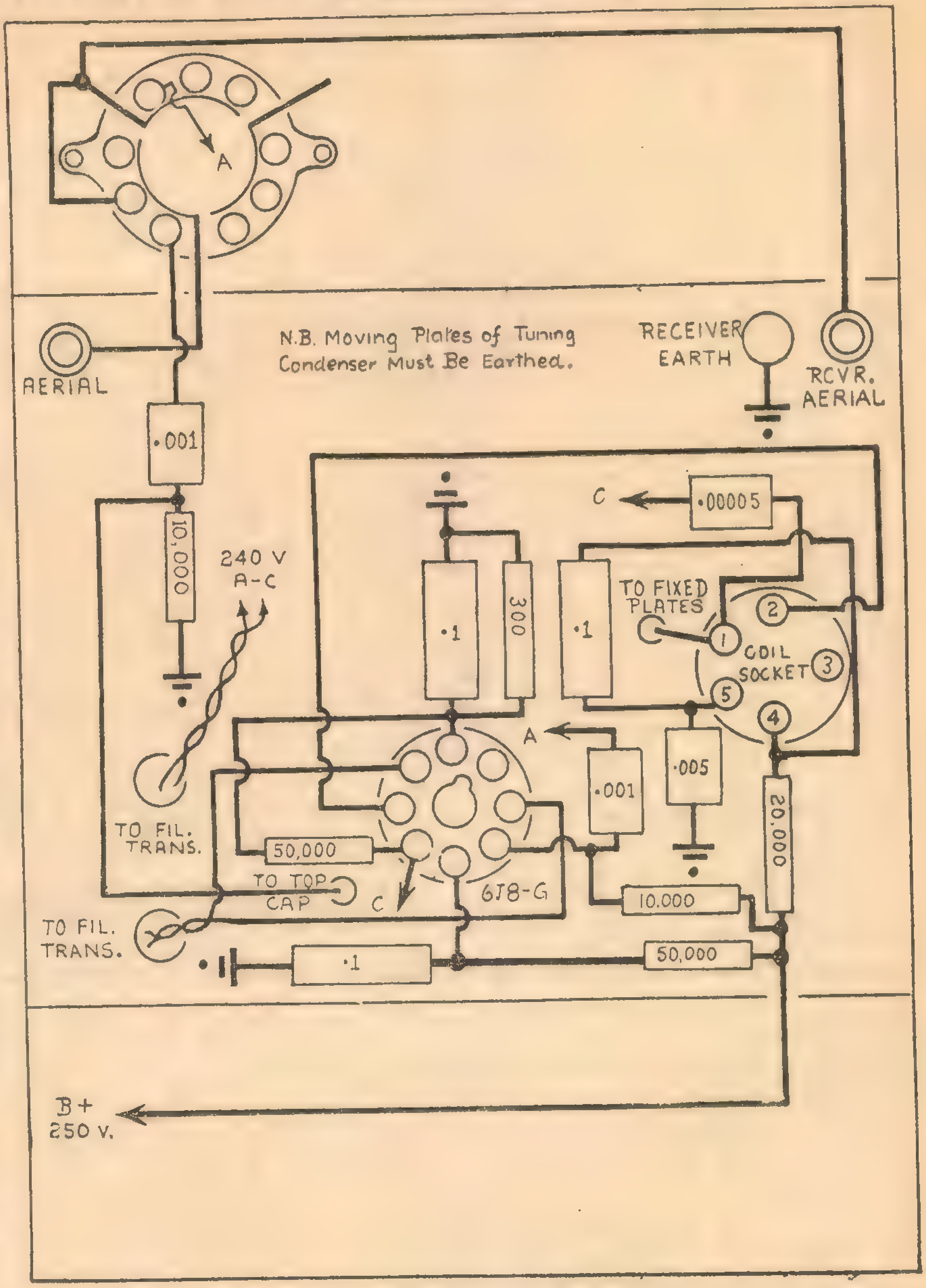

Figure 4. Here is the underneath wiring diagram of the simple short-wave converter. You may not be able to obtain a small chassis to duplicate exactly our layout, in which case the relative positions of the wiring components will be altered. However, the diagram may still be followed, since modification of the layout does not affect the electrical connections.

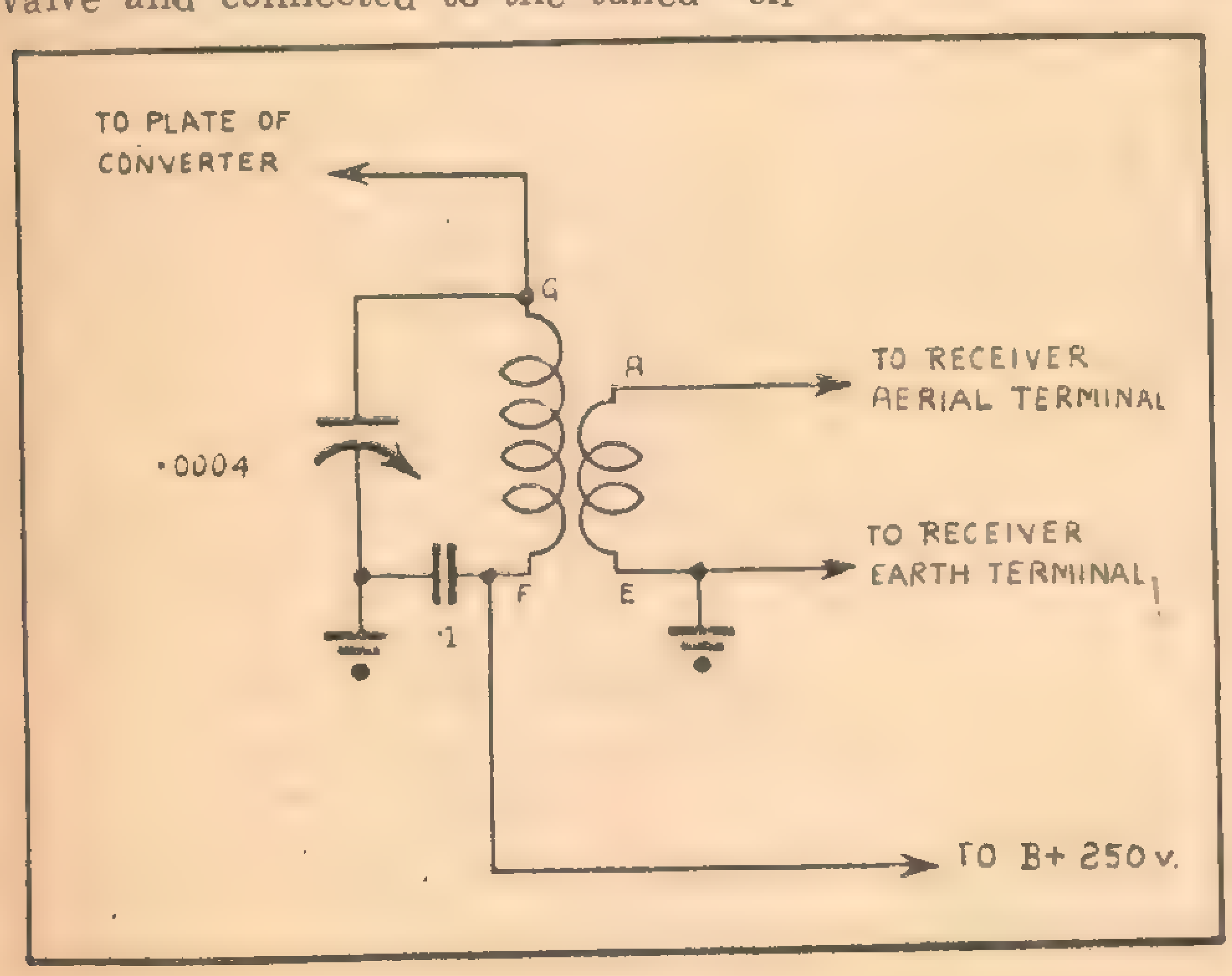

Figure 5. As explained in the text, the method of coupling in the first circuit, although simple, is not as efficient as it might be, particularly when the aerial coil of the B/C receiver has a low impedance primary. A better arrangement is to use a discarded aerial coil in reverse, as shown. The plate circuit may be resonated at a suitable point in the B/C band with a variable condenser, or a fixed condenser in parallel with a trimmer.

SHOWING THE CHASSIS LAYOUT

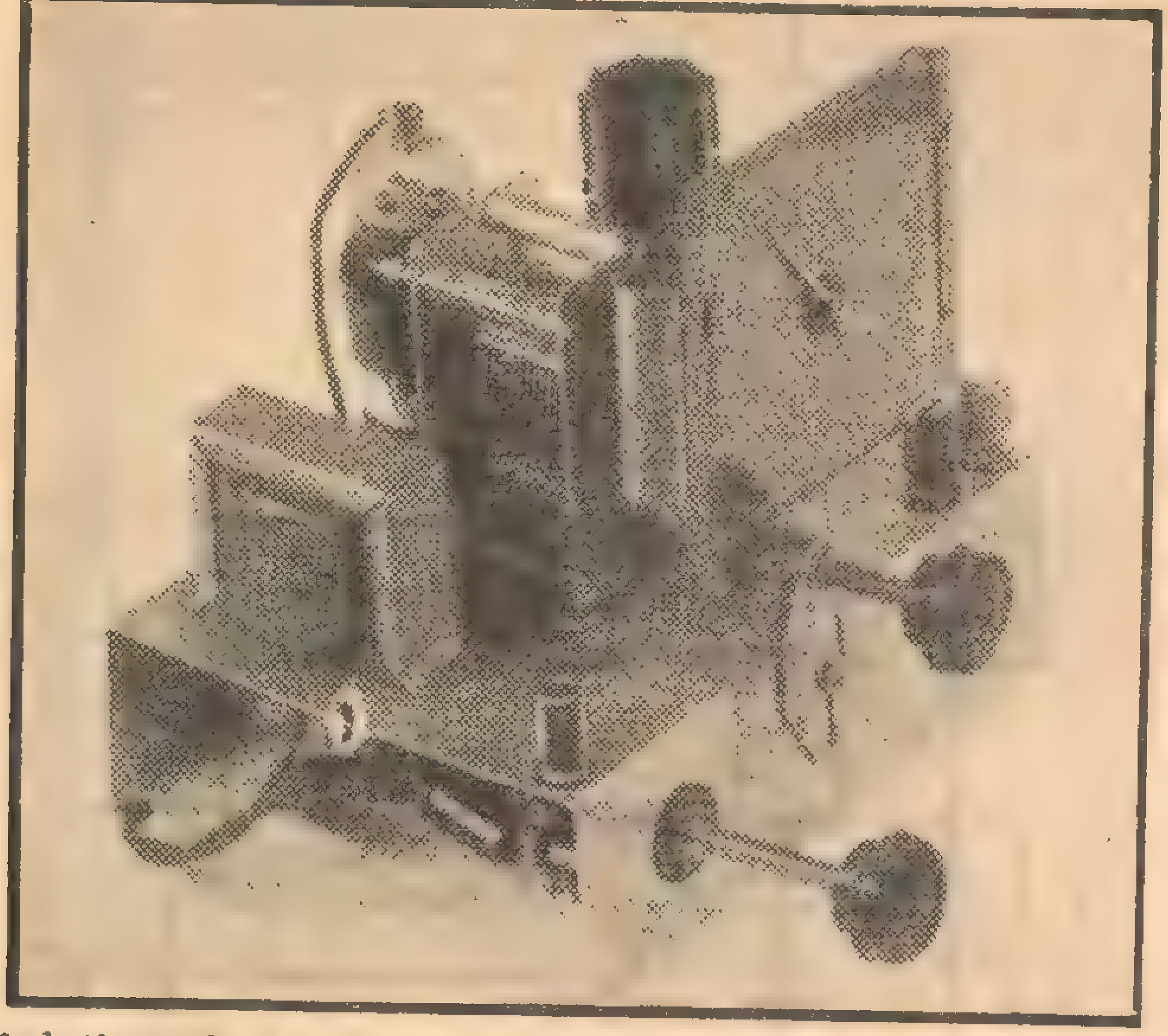

Figure 6. The three photographs on this page give a good idea of the layout adopted for the simple converter. If you have any scrap metal on hand, it should not be a difficult matter to fashion a similar chassis. The terminal in the foreground is for the aerial. The other two terminals on the right-front edge of the chassis have to be connected respectively to the aerial and earth terminal of the broadcast receiver. A short length of shielded cable should be used.

fed through a resistor of 10,000 ohms. This value is not at all critical.

When the D-P-D-T switch is moved in the alternative position, the aerial is connected straight through to the aerial terminal of the receiver, and the connection between the aerial terminal and the plate of the valve in the short-wave converter is broken.

THE HEATER SUPPLY

As shown in the circuit, the heater supply for the valve is derived from a small filament transformer, mounted on a chassis of the converter. This needs to supply the correct heater voltage required by the particular valve used. This would be 6.3 volts for all the types listed save the 2A7, which requires 2.5 volts. If a filament transformer is used, make sure to earth one side of the heater to the chassis.

If you are in a position to bring out a couple of heater leads from the chassis of the broadcast receiver, the filament transformer may be dispensed with. Of course, due care has to be exercised to see that the voltage brought out is the correct voltage for the valve used. In most cases the leads can be attached directly to the appropriate lugs on the power transformer.

You will also need to see that the filament winding is not unduly overloaded by the connection of the extra valve. The only way to be sure is to trace out the number and types of the valves already connected to the winding, and, with the aid of valve charts, add up the total heater current drain. Comparison of this figure and the current rating of the winding, if the rating is marked, will clearly show what the position is.

AVOID LONG LEADS

In most cases ,there is some margin between the actual load and the current rating. In any case, the connection of a single extra valve will seldom lead to trouble. The heater leads should be no longer than necessary in order to avoid excessive voltage drop, especially in the case of the 2.5 volt type, which draws a current of one amp.

If you derive the heater voltage from the receiver, do not earth the heater circuit to the chassis of the converter. The heater circuit will probably be earthed to the chassis of the receiver, and a further connection may result in a partial or complete short-circuit.

The short-wave converter requires a nominal high tension voltage of 250 volts, although anything between about 200 and 275 would do. This voltage may be picked up from the high tension line in the receiver, from such places as the "hot end of the voltage divider, the screen pin of the output valve, or from a point on the loud speaker socket.

With most modern receivers, it can be picked up simply by twisting a piece of wire around the screen pin of the output valve taking due care to avoid creating a short-circuit with the loose end of the wire. However, this is rather a makeshift arrangement, and it is better to make a proper soldered joint to a point beneath the chassis.

In order to have a complete circuit, it is essential to have the two chasses joined together.

The high tension current drain of the short-wave converter will be of the order of 10 milliamps. Most receiver power supplies will stand this addi-

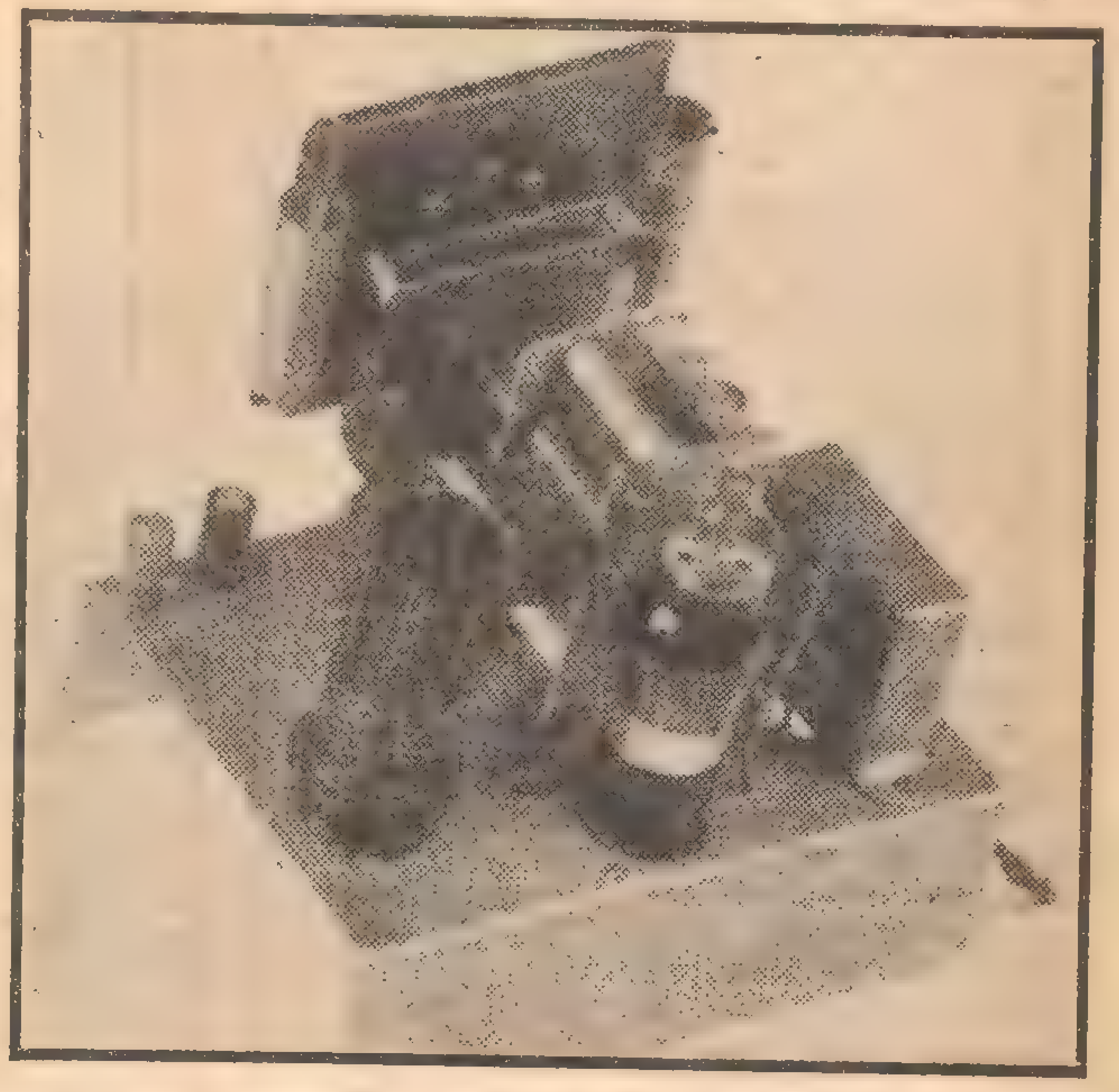

Figure 7. This rear view of the chassis shows very clearly the position of all the major components. The tuning condenser is a modern type, but there is no reason why an older type .0005 mfd condenser could not be used, provided it is in good mechanical condition. The home-made plug-in tuning coil is in the foreground. The converter valve is immediately behind the tuning condenser, with the small filament transformer alongside.

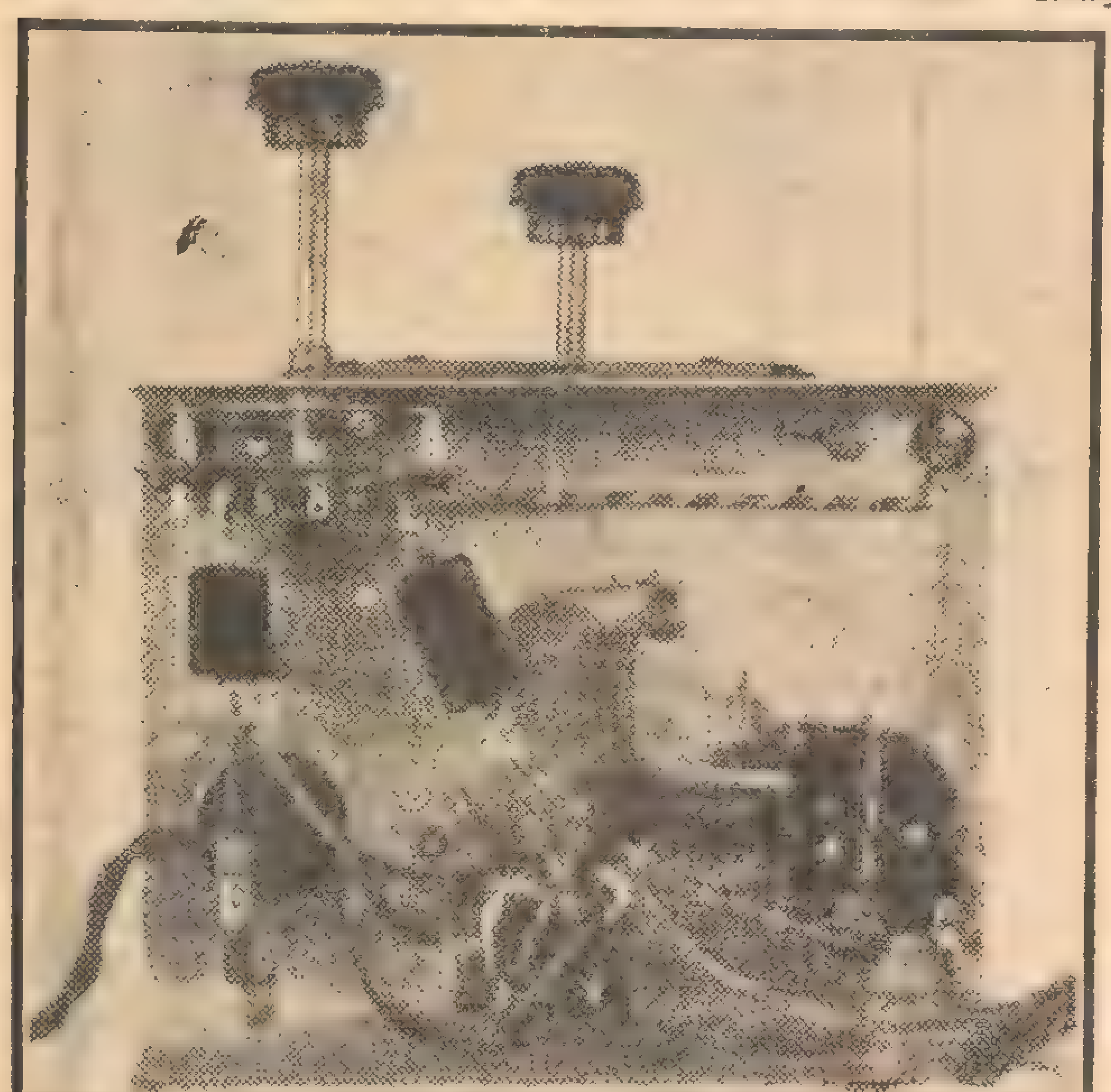

Figure 8. An underneath view of the simple converter. few wiring parts there are are grouped mainly around the valve and coil socket. The lead seen at the right of the chassis is the high tension lead. The twisted lead to the left is the 240-volt connection to the filament transformer. Note the single-bank changeover switch, which may be arranged also to make and break the heater circuit.

tional drain without undue distress. If you cannot check the actual load conditions on the power transformer and rectifier, keep a watchful eye on the temperature of the power transformer, and see that it does not become unduly hot with the converter in operation.

The lead between the converter and the aerial terminal of the receiver should be as short as possible to avoid picking up signals direct. In fact, it is a good plan to use a shielded lead for the purpose, no more than about two feet long.

CONNECTING LEADS

Therefore, the leads connecting to the short-wave converter are as follow:

(a) Two leads for the heater supply; either filament leads from the main receiver or 240 volt leads to the primary winding of the built-in filament transformer.

(b) A high tension lead to a point of high voltage in the receiver.

(c) A shielded lead between the output of the short-wave converter and the aerial terminal of the receiver. The metal shielding may also serve to interconnect the two chasses.

Only a small chassis is necessary to mount the components in this simple short-wave converter. In our original model, we used a small chassis which we raked out from our stock of odds and ends. We will leave it to individual constructors to make their own arrangements in this regard in these difficult times.

CHASSIS LAYOUT

The accompanying photographs and the explanatory notes give a good idea of the layout of the components on the experimental chassis, which you may or may not be able to duplicate. The layout should be compact, but the actual detail need not follow our arrangement. However, see to it that the leads between the oscillator coil, the gang condenser and the valve are as short as possible.

The underneath wiring diagram follows our original layout. If you use a different layout, the wiring components may be placed differently, but the connections will not be altered.

The tuning condenser should have a maximum capacity of about .0004 mfd., which is the approximate figure for a modern single gang. An old style condenser may be used, but the movement should be smooth and free from backlash or sideplay. The type of dial used is unimportant, but should have a vernier movement with a smooth action.

THE TUNING COIL

Rough movement, either in the dial or the tuning condenser will make for difficult tuning.

The tuning coil was wound on a 1¼in. diameter ribbed, 5-pin plug-in former. The grid winding consists of five turns of 24 B. and S. gauge enamel, spaced to occupy half an inch of winding length. The plate winding is wound with 32 B. and S. gauge enamel, interwound from the "cold" end of the grid winding.

Both coils must be wound in the

DETAILS OF THE COIL

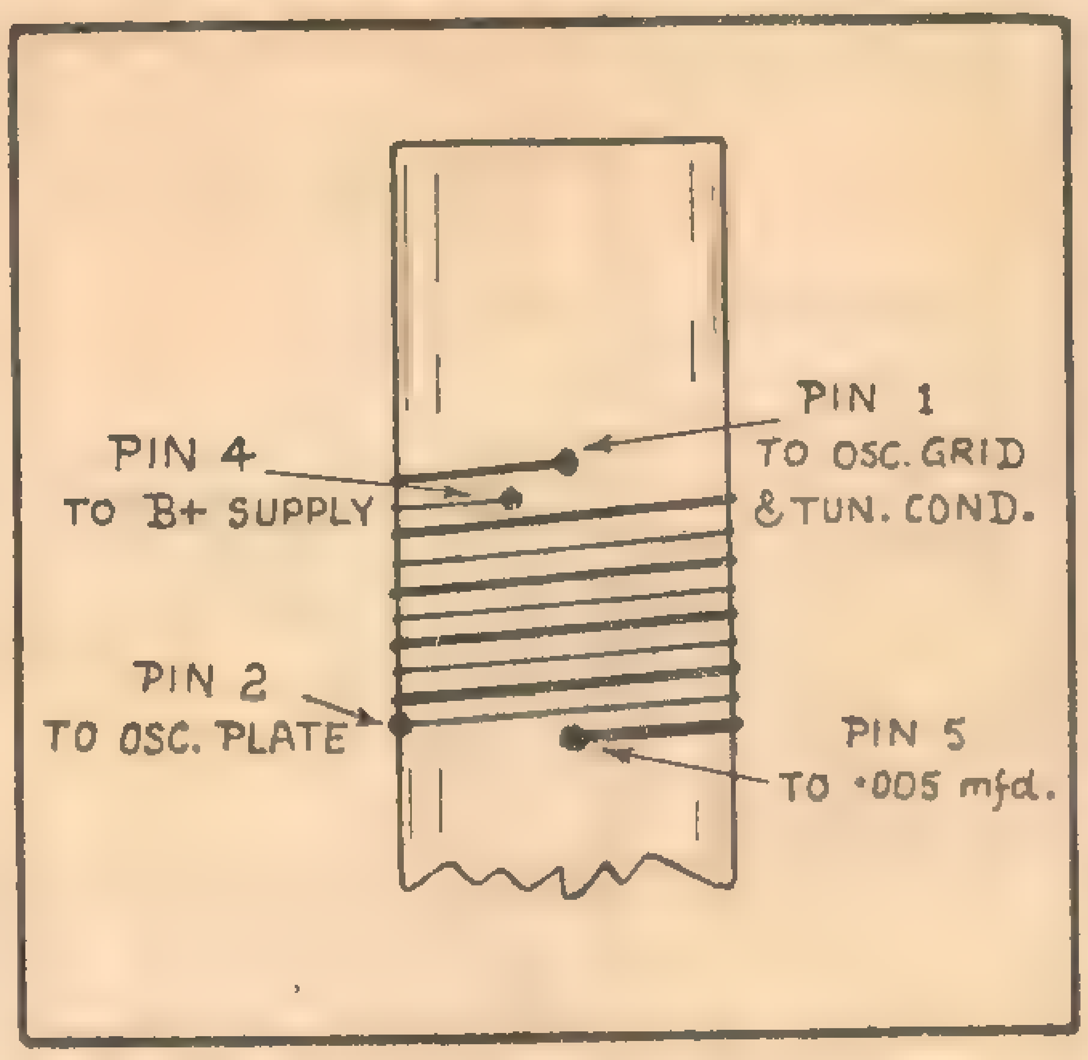

Figure 9. When you have wound the coil according to the data given in the text, the connections are made to the pins as shown above. Before actually winding the coil, drill four small holes through the former with a fine nail, through which to pass the wires. The tuning range will be approximately 13 to 40 metres.

same direction. The connections to the pins of the plug are clearly illustrated in the accompanying drawing. The pin numbers correspond exactly to the numbers on the coil socket in the underneath wiring diagram. Either a four or six-pin former may be substituted, provided that the correct connections are made to the coil.

CHANGE-OVER SWITCH

The short-wave to broadcast change-over switch used was a 3 x 3, single-bank wave-change switch. Only two sets of contacts are used. The third set of contacts may be utilised to break the heater supply, so that the heater is switched off when the switch is set to the "broadcast" position. This will eliminate the high tension drain of the short-wave converter, and save wear and tear on the valve.

If the heater supply is derived from the main receiver, there will be no complication about breaking the heater circuit. If a filament transformer is used, we are inclined to favor breaking the low tension circuit. It will not

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OUR SECOND S-W CONVERTER CIRCUIT

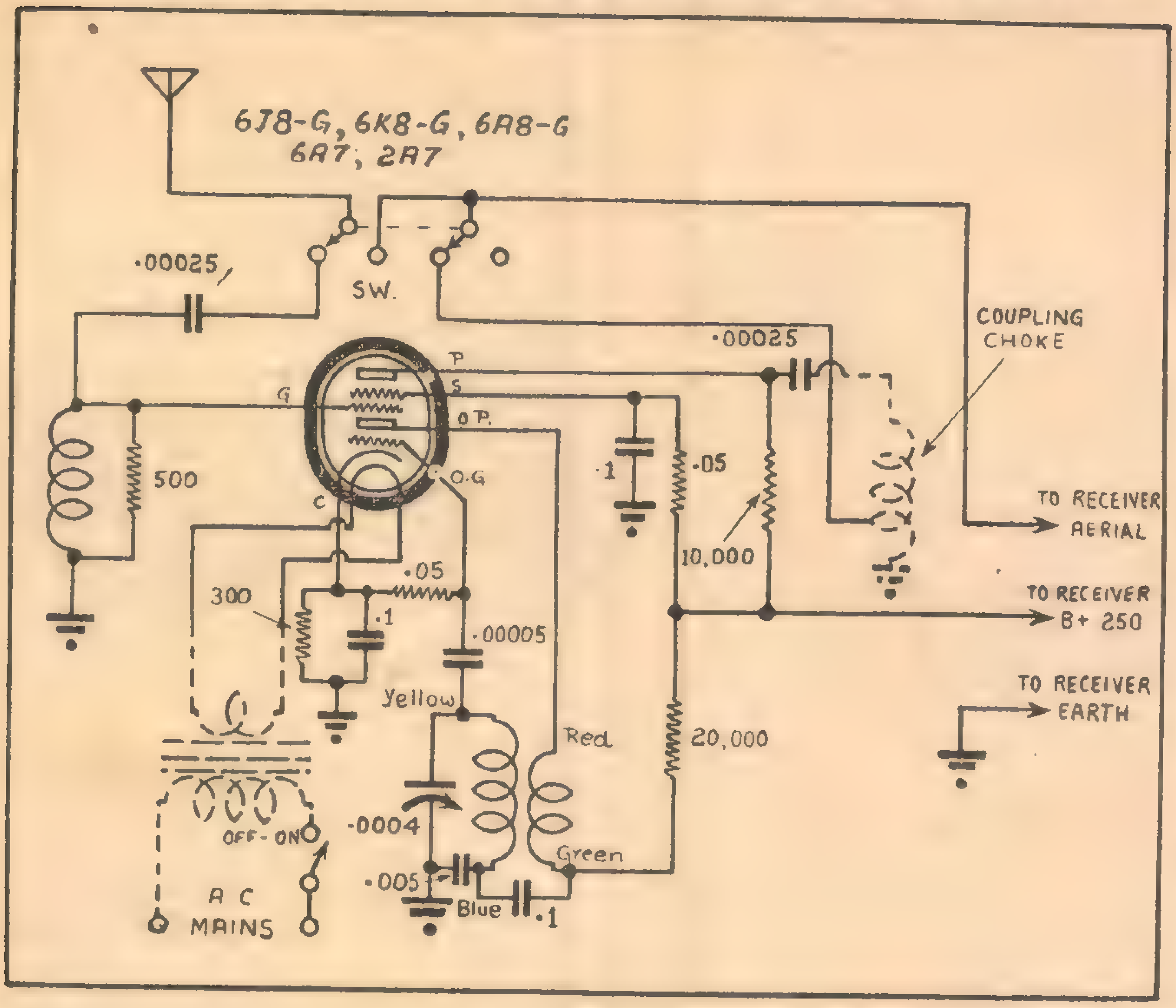

Figure 10. The second short-wave converter circuit, built up around the RCS coil kit. Main point of difference is the coil forming the return path for the signal grid. Broadly resonant within the short-wave band, this circuit discriminates against signals from stations on the broadcast band. The output circuit may be exactly as in the simple converter. However, RCS have available a tapped coupling choke, which may give rather better overall gain operating into with certain low impedance aerial coils.

hurt either the filament transformer or your electric light account if the transformer is left on all the time the receiver is in operation. We are not at all keen on having the mains voltage on the exposed lugs of a wave change switch.

However, we will leave the details of this matter to you. In whatever manner you do it, the idea is to remove the heater voltage from the valve in the converter during the time it is not in use.

DISADVANTAGES

The very simple circuit has certain disadvantages, which compromise the performance. The first is in regard to the method of coupling to the broadcast receiver. You will note that the plate of the converted valve is simpl[y] fed through a resistance and couple[d] to the aerial terminal of the receive[r] through a small condenser.

When the aerial coil of the broad-cast receiver has a high impedanc[e] primary winding, the coupling is reasonably efficient. This is not true, however, for receivers with a low impedanc[e] aerial coil.

Without laboring the point, it is possible, in such cases, to arrange a satisfactory impedance matching circuit b[y] using a discarded aerial coil as the output coil of the short-wave converter. The method of coupling the coil is clearl[y] shown in figure 5. The coil is use[d] back-to-front, the normal grid winding serving as the plate winding and the usual primary as the output winding.

ADJUSTING CIRCUIT

The plate winding should be resonated at a suitable point in the broadcast band by connecting across it either a .0005 mfd. variable condenser or a mica fixed condenser of about .00025 mfd. in parallel with a trimmer for purposes or adjustment.

The adjustment may be carried out as follows: First tune the broadcast receiver to a point on the band which is as clear as possible of stations; next, tune in a short-wave signal on the converter and adjust the condenser across the converter output coil for maximum signal strength. If you use a fixed condenser in parallel with a trimmer, you may have to juggle the capacitances to obtain a peak within the range of adjustment of the trimmer.

Having adjusted things, leave the converter coil tuning set, and when using the short-wave converter make a point of setting the tuning dial of the broadcast receiver at exactly the same position. In fact, with any short-wave converter, the broadcast receiver dial should be set to a given position each time, as a different setting will affect the position of the stations on the tuning dial of the converter.

LOW AND HIGH IMPEDANCE

A low or high impedance aerial coil can be identified by inspecting the primary winding. A low impedance primary winding usually takes the form of about 15 turns of wire in proximity to the "cold" end of the grid winding. A few low impedance windings will be found to be very small honeycomb windings, no more than 3-8in. diameter, within the coil former.

PARTS LIST FOR CONVERTER NUMBER 2

1 Small chassis to suit.
1 6.3 volt filament transformer (if required).
1 Off-On switch (if required).
1 Single-gang variable condenser, .0004 mfd.
1 Vernier dial to suit requirements.
1 3 x 3 single-bank wave-change switch.
1 R.C.S. aerial coil unit.
1 R.C.S. oscillator coil.
1 R.C.S. tapped coupling choke (if required).
1 500 ohm resistor, W.W.
1 10,000 ohm resistor, 1 watt.
2 50,000 ohm resistor, 1 watt.
1 20,000 ohm resistor, 1 watt.
1 300 ohm resistor, W.W.
3 0.1 mfd. tubular condensers.
1 .005 mfd. mica condenser.
2 .00025 mfd. mica condensers.
1 .00005 mfd. mica condenser.
1 Octal valve socket, or as required.
VALVE: 1—6J8-G, or alternative type, as suggested.
SUNDRIES: 3 terminals, 2 or 3 knobs, as required, 1 grid clip, hookup and shielded wire, nuts, bolts, solder lugs, etc.

A high impedance primary, on the other hand, consists usually of a honeycomb winding of quite large dimensions. If you decide to use a coupling coil, as in figure 5, see to it that the coil corresponds to the type of coil in your receiver—that is with regard to the impedance of the primary.

There are other methods of matching the aerial coil impedance of the broadcast receiver, one of which we shall discuss presently in connection with the RCS coil kit.

RESISTIVE INPUT

If you refer again to the circuit of the simple converter, you will note that the input circuit to the grid of the converter valve is resistive in character. It does not possess any characteristics of frequency discrimination worth speaking of, and is equally responsive to signals from stations either in the broadcast or short-wave bands—or to any other signals in between those bands.

The many signals impressed on the signal grid of the converter valve are amplified by the mixer section and appear in the plate circuit, irrespective of the mixing action of the valve. In other words, the mixer portion of the valve acts as an untuned r-f amplifier. Even though the amplification may not be high, at least the signals are passed through to the aerial terminal of the broadcast receiver.

The signals passed through naturally include all the broadcast stations, and this complicates considerably the problem of finding a clear spot in the broadcast band to which the broadcast receiver may be tuned. With a sensitive receiver, in the vicinity of strong stations, it may be impossible to find a clear position on the dial. Herein lies the greatest limitation of the simple circuit.

TUNED INPUT CIRCUIT?

The difficulty may be overcome by substituting for the resistive input circuit a circuit which will pass the short-wave signals but discriminate against the signals from broadcast stations. The obvious answer is a tuned input circuit.

However, a tuned input circuit means either another tuning control, in addition to the oscillator tuning control, or a set of matched tuning coils and a two-gang condenser. This is a complication which you may or may not be prepared to tolerate.

An alternative is to arrange a heavily-damped input circuit which is broadly resonant within the short-wave band. Although such a circuit may discriminate effectively against unwanted signals on the broadcast band, it does not require an extra variable tuning condenser.

SECOND CONVERTER

Our second short-wave converted circuit is designed around the commercial coil kit made available by RCS radio. The circuit is shown as figure 10, and the complete coil kit in figure 11.

In most respects, the circuit follows that of the simple converter discussed earlier. All the previous remarks in regard to the valves, the heater and high tension supplies, the switching and the connections to the broadcast receiver, still hold good.

Figure 11. Here are the components comprising the RCS short-wave converter coil kit. The sealed unit at the rear left is the aerial coil. Alongside it, with the four lugs showing clearly, is the oscillator coil. Between them is the 500 ohm wire wound resistor. The tapped output choke is on the right. When the photograph was taken, it was intended also to employ the r-f choke on the left, but this was subsequently found to be unnecessary.

The main differences are in regard to the input and output circuits. The input circuit will be seen to consist of a coil shunted by a 500 ohm resistor. The coil is not tuned by any external condenser, but the design is such that it favors signals within the desired short-wave band. The actual resonant peak will be affected by the associated circuit constants, but the heavy damping does not allow the peak to become too obvious.

The RCS coil is contained in a sealed tube and has two connections. This is simply connected in place of the 10,000 ohm resistor used in the first circuit. The 500 ohm resistor is then wired across the two terminals of the coil to provide the necessary resistive loading.

In practice, this particular unit is very effective and prevents all but the strongest signals passing through the converter to the aerial terminal of the receiver.

However, its value will be lost if the lead between the converter and the aerial coil of the receiver is not shielded and as short as possible. The receiver chassis should also be earthed to a water pipe or by some other effective means. Failure to observe these precautions may result in unwanted direct pickup of broadcasting stations, irrespective of the special aerial coil.

The RCS oscillator coil is wound on a $\frac{3}{4}$in. diameter former, fitted with lugs for permanent mounting above or below the chassis, whichever position is the most convenient. It has four connections in all, which are color-coded to facilitate wiring. The key to the color code is given in the accompanying table.

You will note that, in this circuit, as well as the previous one, the "cold" end of the oscillator grid winding is connected through a .005 mfd. condenser to earth, instead of being earthed direct. The 0.1 mfd. bypass condenser on the plate winding is returned to this junction, instead of the earth.

This is our old friend "padder feedback" in another guise.

CONNECTIONS FOR THE RCS COIL KIT

AERIAL COIL: Has two connections only. It is immaterial which way round the coil is connected into circuit.

RESISTOR: Is a standard 500-ohm wire-bound unit, to be connected directly across the terminals of the aerial coil.

OSCILLATOR COIL: Has four lugs, color-coded as follows: Yellow—through the .00005 mfd. grid condenser to the oscillator grid. Blue—through the .005 mfd. condenser to earth. Red—to the oscillator anode. Green—through the 20,000 ohm resistor to B plus.

TAPPED OUTPUT CHOKE: Has three connections, as follow: The mounting screw and the lug connecting to it should be earthed. The lug connecting to the outside of the winding goes to plate, through the coupling condenser. The lug connected to the tapping is for connection to the receiver aerial terminal. Note that this choke is only intended for use where the broadcast receiver has a low impedance aerial coil.

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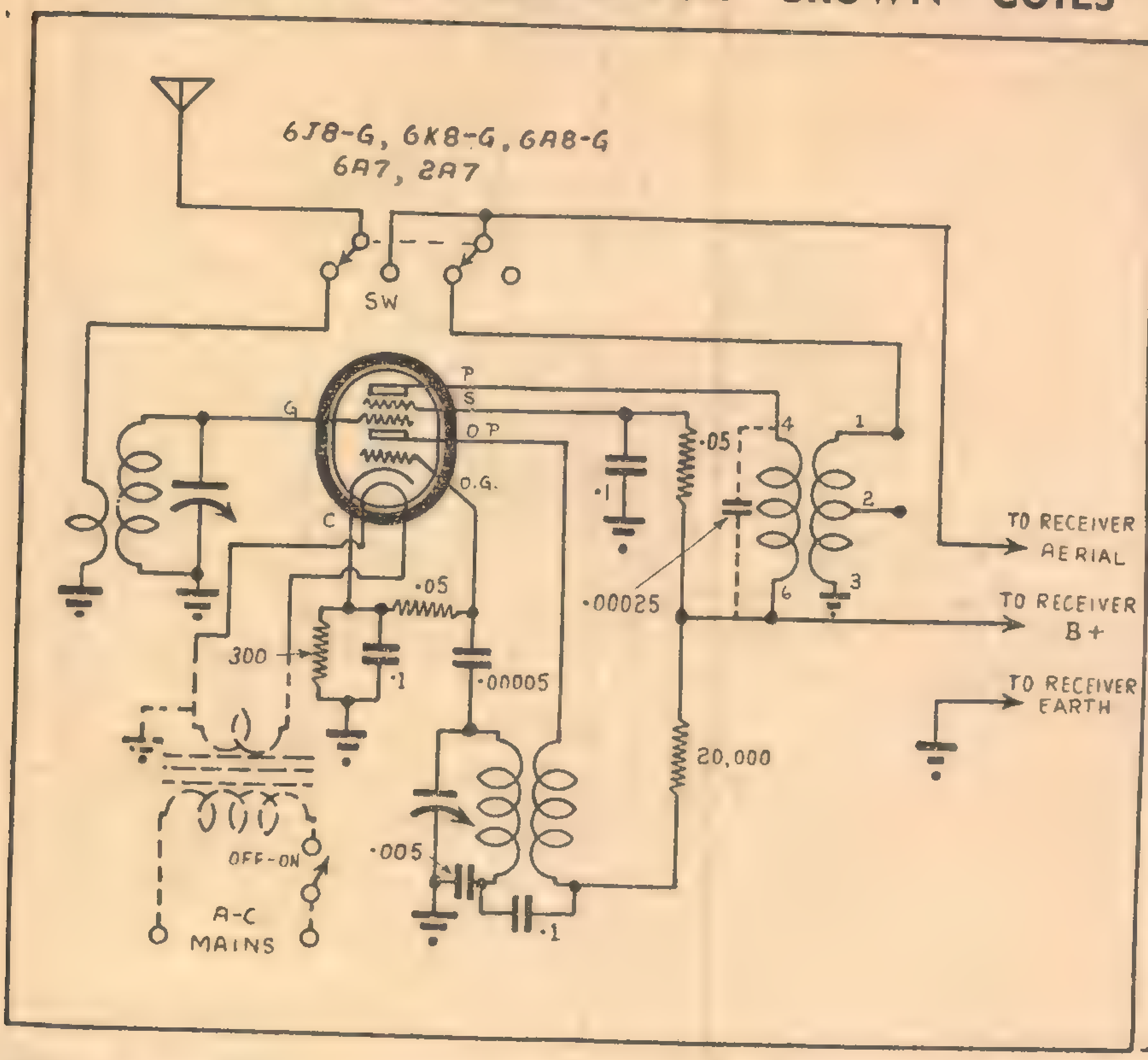
SHORT-WAVE CONVERTER FOR "CROWN" COILS



Our third short-wave converter circuit is built around the "Crown" coil kit, which is a rather more elaborate affair than the RCS kit. It is more difficult to wire up; it requires the use of a good two-gang condenser and, when completed, there are a number of adjustments to be made.

THIRD CIRCUIT

However, in return for the extra complications and cost, rather better results are to be had. We can make these statements without fear of giving offence, because the two kits are quite distinct, the manufacturers having approached the problem from a different angle. One has chosen to keep the kit simple. The other has preferred to seek the best possible results, irrespective of complication and cost.

Figure 12. Here is the third shortwave converter circuit, designed around the "Crown" coil kit. It employs a tuned aerial circuit and requires the use of a two-gang tuning condenser. Note the tuned plate circuit with a tapped output winding; one tapping is for low impedance aerial coils, the other for high impedance coils. This converter is capable of giving excellent results.

Referring to the circuit diagram shown in figure 12, an obvious difference to the earlier circuits is the use of a sharply tuned aerial input circuit coupling to the signal grid of the converter valve.

Apart from the ability to reject stations outside the short-wave band, the advantage of a sharply tuned aerial circuit is in the limitation of "image" reception. The phenomenon of image reception is not difficult to understand in the light of our earlier remarks.

You will remember that a signal is heard from the B/C receiver when the difference in the frequency of the short-wave station and of the local oscil-

There is actually no need for the padder at all in this circuit. However, the padder feedback scheme is quite easy to incorporate and it serves the very useful purpose of maintaining the oscillator grid current at the low frequency end of each band. This is very real advantage if the converter valve used is one which has seen better days.

If the broadcast receiver has a high impedance aerial coil, there is no great need to depart from the simple resistance-capacity output coupling, as used in the first circuit. If the primary impedance of the aerial coil is low, the impedance matching scheme shown in figure 5 may be incorporated, although this means additional complication, both in construction and adjustment.

TAPPED COUPLING CHOKE

RCS have made available a special tapped coupling choke which does not require to be tuned but which provides a degree of impedance matching. The connections are shown dotted in figure 10.

The plate of the converter is fed through a parallel of 10,000 ohm. resistor and coupled to the choke through a .00025 mfd. mica condenser. We originally tried a standard r-f choke as the parellel feed path but it did not appear to be as satisfactory as the resistor. A very high impedance r-f choke might be a better proposition but such units are scarce at the moment and relatively costly.

The details of the output circuit are open to a certain amount of experimenting to suit individual broadcast receivers. It is really a matter of trying out the various methods to see which gives the highest overall gain.

When comparing different methods, try out one immediately after the other. If you allow a couple of hours to elapse between tests, the reception conditions for the various overseas stations may have changed sufficiently to render meaningless direct comparative tests.

NO ADJUSTMENTS

The untuned aerial circuit makes for simplicity both of construction and adjustment. In fact, unless you have rigged up the tuned output circuit mentioned earlier, there aren't any adjustments to make. Simply connect the converter to the broadcast receiver, set the change-over switch to the "short-wave" position, set the tuning dial of the receiver and then proceed to search for stations on the dial of the converter.

As you will discover, considering the simplicity of this little converter, it performs in excellent fashion. If you have a reasonably sensitive broadcast receiver, a satisfactory aerial and earth, and if everything is working as it should, you should have no difficulty in logging several short-wave stations at full loud-speaker strength. Of course, reception conditions vary with the time of day; study the short-wave notes in this issue for information as to the best time to listen.

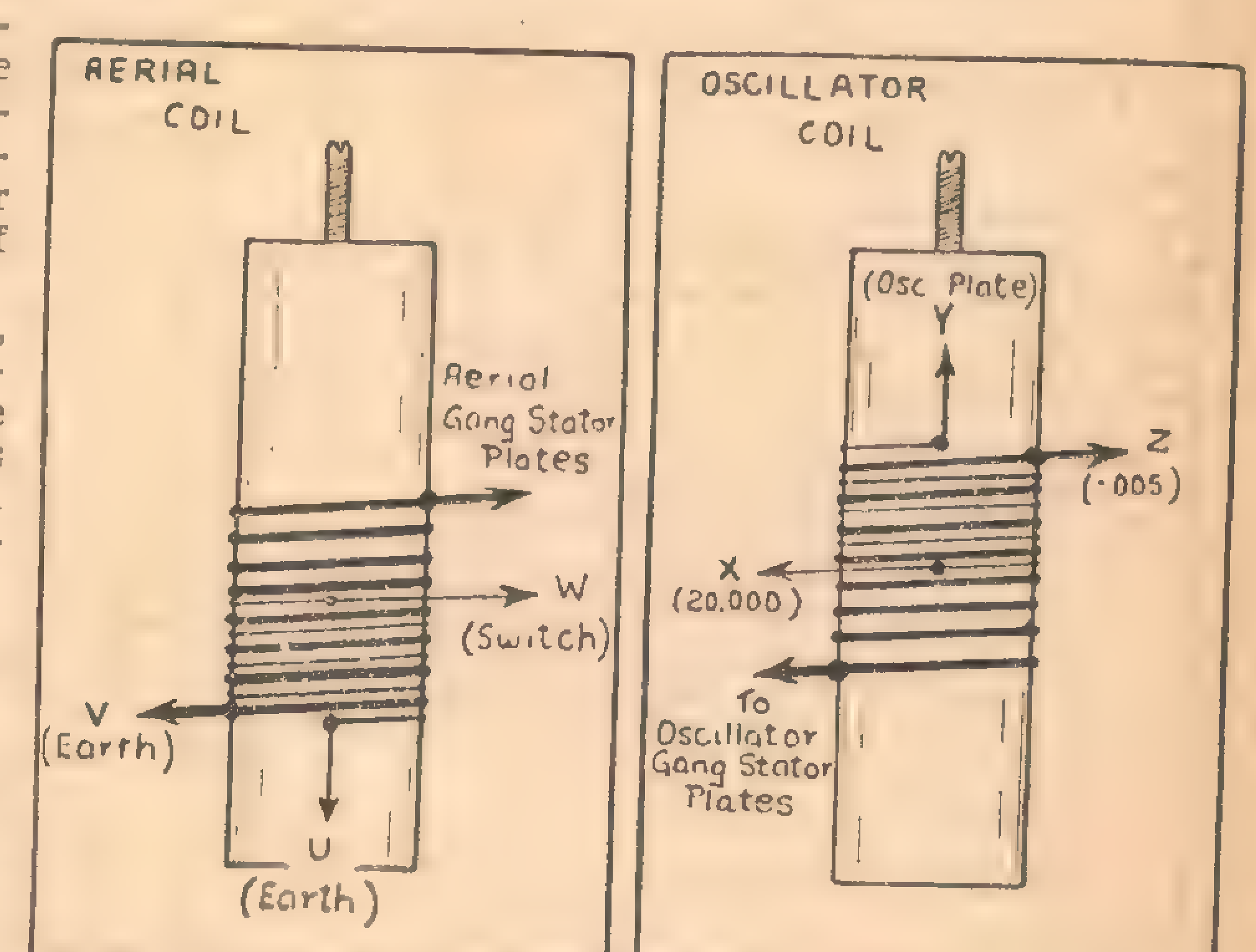


Figure 13. The "Crown" coils are not colour coded, but you should not have much difficulty in wiring them up if you follow the above diagram. The individual coils may be identified by noting the position of the primary windings with respect to the adjusting screw for the iron cores. The oscillator coil is upside-down with respect to the aerial coil, as shown in the diagram.

lator is the same as the frequency to which the broadcast receiver is tuned.

However, with any given short-wave signal, the desired frequency difference can occur twice—once with the oscillator at a higher frequency than the station and a second time with the oscillator at a lower frequency than the station. Thus it is that, as either of the simpler converter circuits are tuned across the short-wave bands, each station is heard at two distinct positions, separated, perhaps, by half to one inch of dial space.

This is rather confusing but, for casual listening, it is not very important, when one has learned where to look for the different stations.

SIGNAL FREQ. CIRCUITS

If, ahead of the converter valve, one arranges one or more tuned circuits, so adjusted and made to "track" that they always resonate to one side of the oscillator frequency, then the signals on that side of the oscillator frequency are favored more than those on the opposite side.

In current practice, it is usual to arrange matters so that the oscillator functions at a higher frequency than the resonant frequency of the signal tuned circuits. Signals at a frequency higher again than the oscillator frequency are greatly attenuated before they reach the grid of the converter valve, because of the selectivity of the tuned circuits.

Even though the frequency may be such as to produce the particular "beat" frequency concerned, the amplitude may be so small as to be neglected.

CONNECTIONS FOR CROWN OUTPUT COIL

1. High impedance output tap.
2. Low impedance output tap.
3. Earth.
4. Plate.
5. No connection.
6. B plus supply.

As a general rule, a single tuned circuit is not sufficient completely to suppress the unwanted or "image" responses, but it is a distinct help and makes for easier identification of the different stations and wavebands.

The usual 4/5 valve dual-wave receiver incorporates a single tuned circuit ahead of the converter valve and has a two gang tuning condenser.

In the Crown coil kit, both the aerial coil and the oscillator coil are of the iron-cored variety. The position of the iron cores in the coils may be varied to allow adjustment of the inductance and the tracking.

TRIMMERS NECESSARY

In addition to the core adjustment, it is necessary to provide trimmers across each tuned circuit for adjustment at the high frequency end of the band.

If your gang condenser is already fitted with trimmers, these will serve the purpose quite well. Otherwise, it will be necessary to connect a separate trimmer in parallel with the aerial and

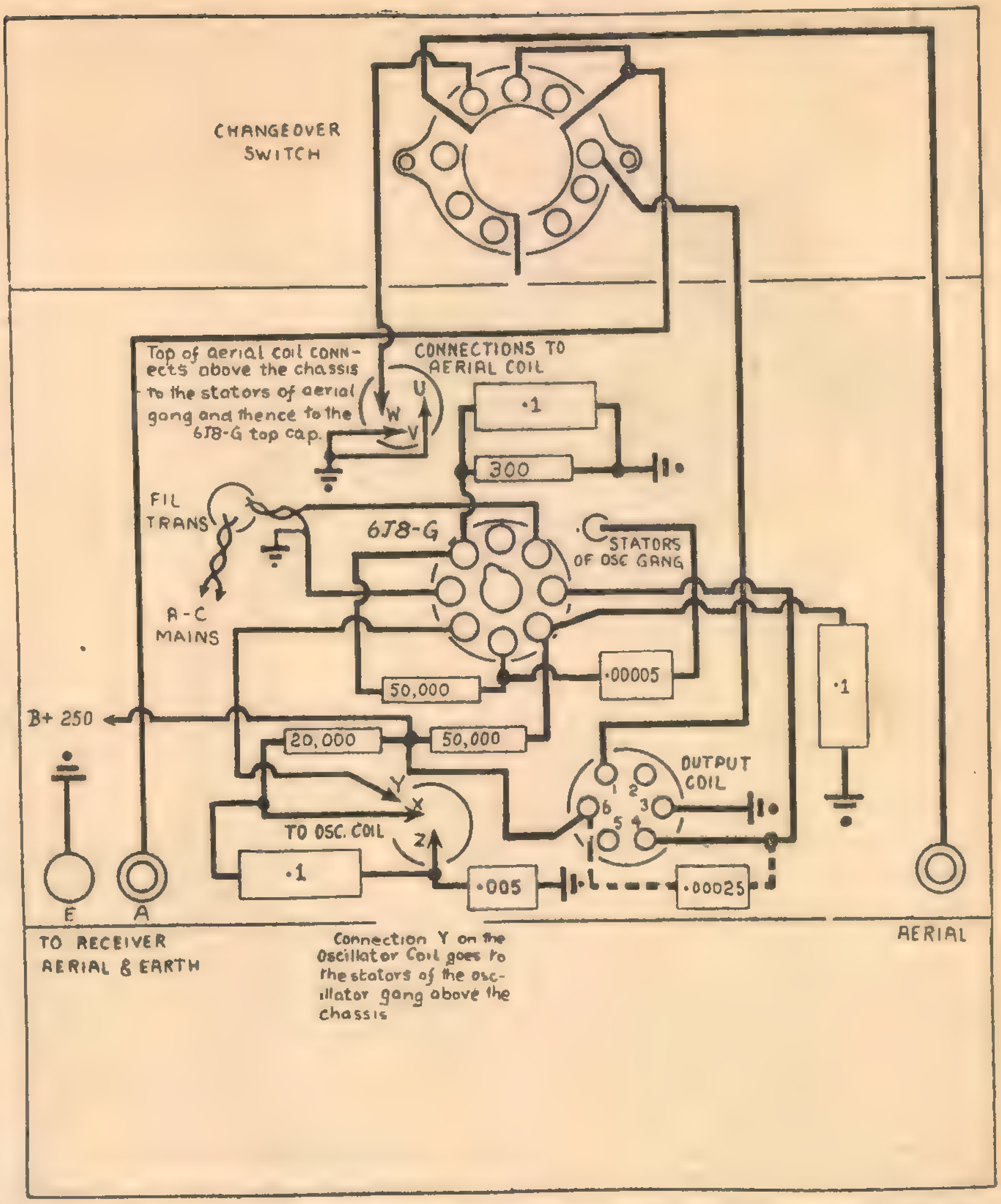


Figure 14. Here is the underneath wiring diagram of the third short-wave converter employing the "Crown" coil kit. Most of the connections are clear. Note that the "hot" ends of both the oscillator and aerial coils are connected to the respective sections of the tuning gang above the chassis. The front section is the aerial tuning, the rear section the oscillator tuning.

the oscillator tuned circuit. It does not matter very much where the trimmers are located, provided that they are accessible and do not require long additional leads.

In our case, we simply mounted the trimmers on top of the gang condenser, taking care to see that the adjusting screws were at earth potential.

The best gang condenser to use with this converter is the modern "H" type. Provided that they are in good mechanical condition, any one of the earlier types could be pressed into service. Depending on their minimum capacitance, they may or may not tune down to the 13-metre band. However, the 13-metre band is probably the least important of all and is very dead for most of the year.

The Crown coils are not color-coded, but the accompanying sketches show clearly how to connect the various leads. The oscillator coil is upside-down with respect to the aerial coil and each may be identified by comparison with the sketch.

(Continued on Next Page)

PARTS LIST FOR CONVERTER 3

- 1 chassis, $8\frac{1}{2}$ x $5\frac{1}{2}$ x $2\frac{1}{4}$ (Little General).
- 1 Crown coil kit: 1 aerial, 1 oscillator, 1 output coil.
- 1 2-gang tuning condenser.
- 1 tuning dial, scale 0-100.
- 1 6.3v filament transformer (if required).
- 3 .1 mfd tubular condensers.
- 1 .005 fmd mica condenser.
- 1 .00005 mfd mica condenser.
- 1 .00025 mfd mica condenser (if required).
- 2 50,000ohm resistors, 1 watt.
- 1 20,000 ohm resistor, 1 watt.
- 1 300 ohm resistor, WW.
- 2 trimmers.
- 1 3 x 3 single-bank wavechange switch.

VALVE: 1 6J8G (or alternative as suggested.

SOCKET: 1 Octal.

SUNDRIES: 2 knobs, 3 terminals (2 red, 1 black), 1 dial drive, 1 small grid clip, shielded and hook-up wire, nuts and bolts, etc.

CONVERTER NUMBER THREE

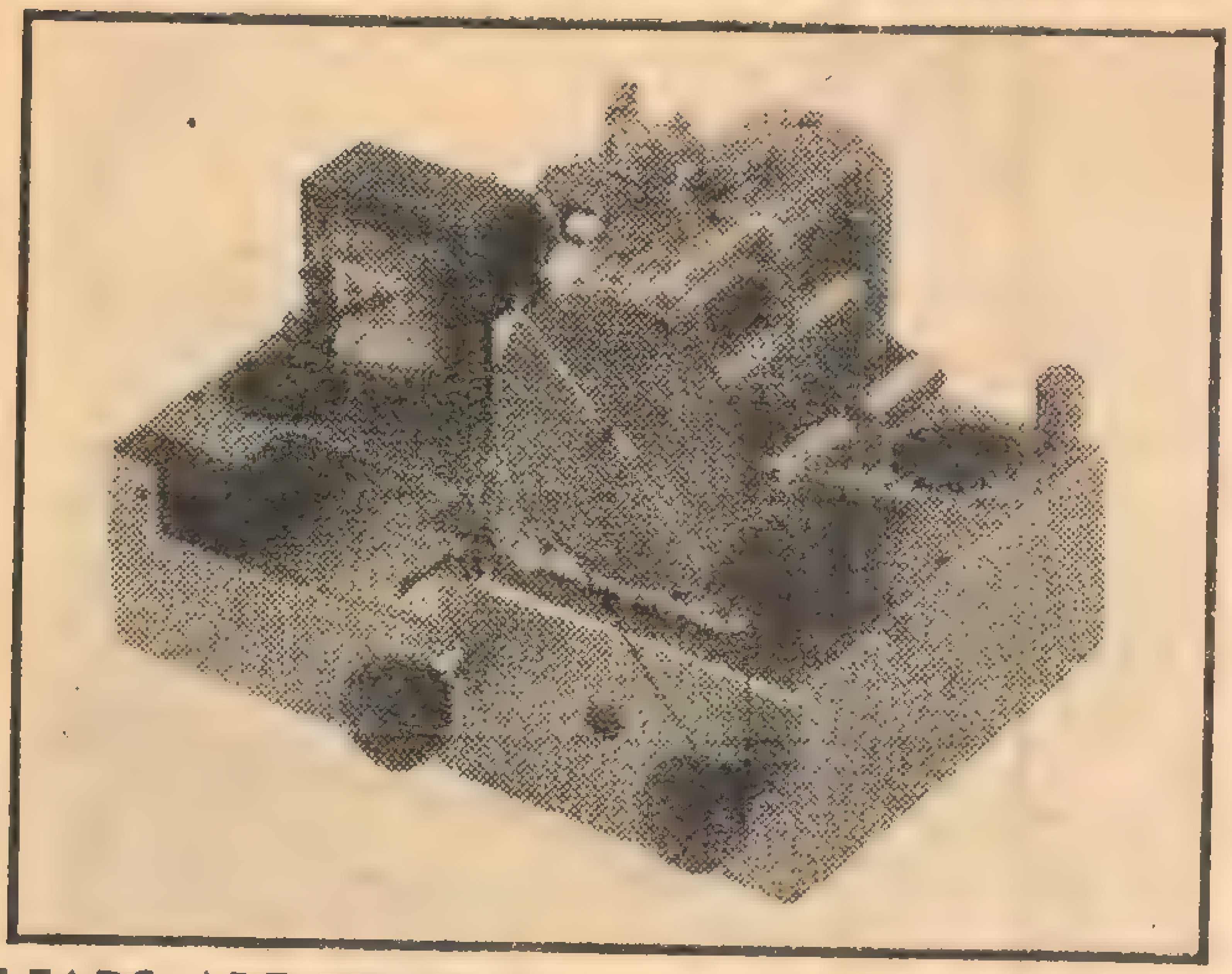


Figure 15. To save having to specify a new chassis we built up the number 3 converter on the "Little General" chassis, with the idea of housing it in the "Little General" cabinet, as illustrated at the beginning of the article. Watch carefully where you mount the controls so that they will correspond to the holes in the cabinet.

LEADS ARE FRAGILE

When you are connecting up the coils, be careful not to twist the leads about any more than you can help. If twisted badly, or subjected to strain, they may break off at the point where they join the coil. Leads passing through the chassis should be protected by lengths of small gauge spaghetti tubing.

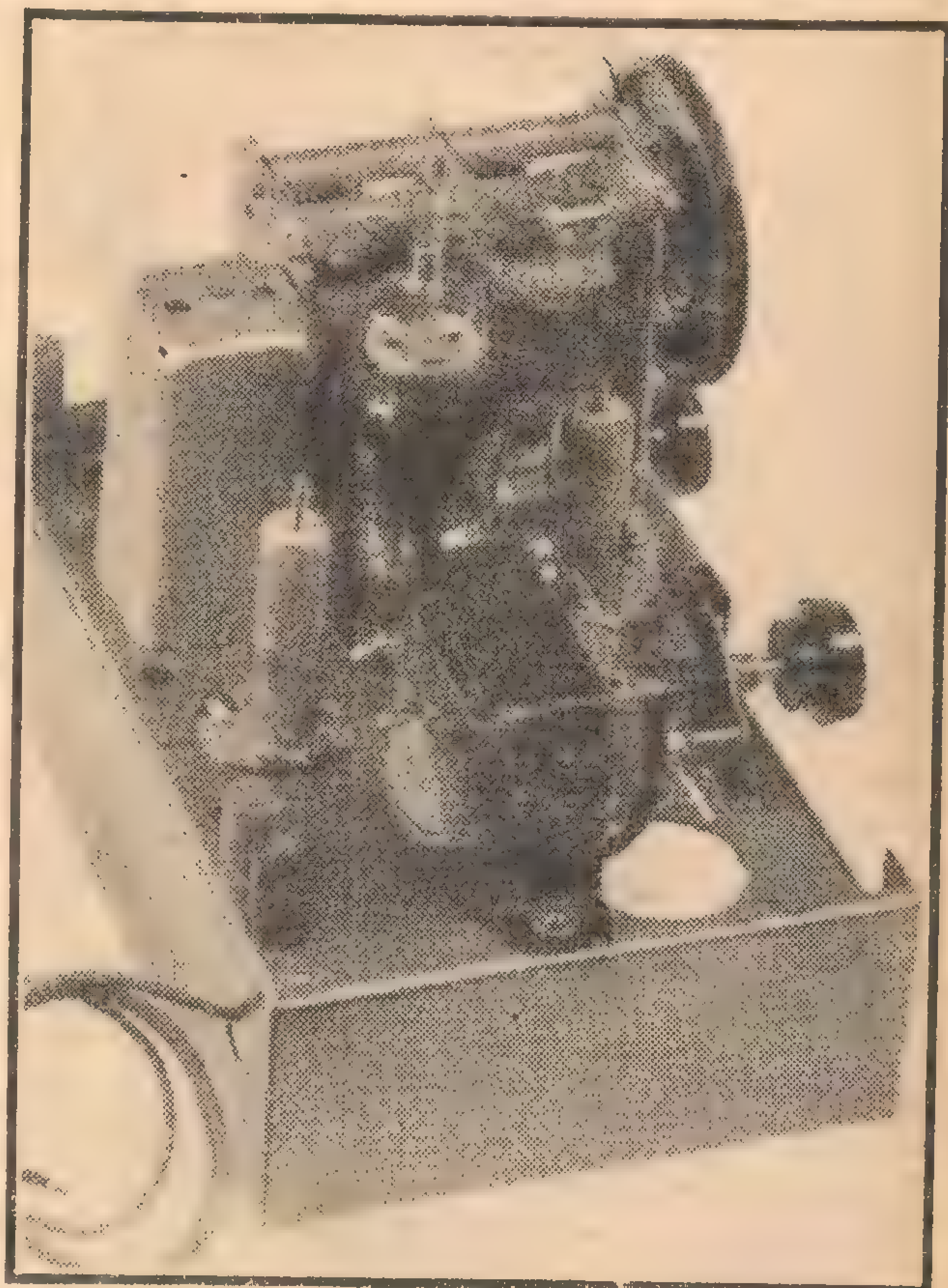
The Crown output coil is a double-wound affair. The primary is intended to be resonated within the broadcast band; the secondary has two tappings, one for use with low-impedance aerial coils and the other for high impedance coils. When wiring up the converter, make the output connection to the appropriate tapping for your receiver, leaving the other tapping blank.

The output coil is mounted within a standard I-F transformer can and has a single trimmer screw, visible at the top. As it stands, the plate winding of the output coil may be resonated within the approximate limits of 1400 and 1600 Kc/s, which is the high frequency end of the broadcast band.

EXTRA CONDENSER

If, in your location, you can find a clear spot on the broadcast receiver dial within this frequency range (make the test with the converter coupled up in the normal manner), the receiver may be left tuned to the setting and the trimmer on the converter output coil peaked up for maximum output.

Figure 16. This picture gives a good idea of the layout of the components above the chassis. The aerial coil is toward the front of the chassis, the oscillator coil at the rear. The output coil, in the can, is immediately behind the gang condenser and the valve. Note the trimmers mounted on top of the gang.



On the other hand, if you find that broadcast stations tend to "chip-in" when the receiver is set within the 1400-1600 kc/s limits, you may be able to do better by tuning the receiver well up towards the law-frequency end of the band. This is well outside the range of the trimmer fitted to the converter output coil and it is necessary to fit a parallel capacitance, external to the coil. In practice, a 00025 mfd. seems to work quite well. The connections for this extra condenser are shown dotted, both in the circuit and the underneath wiring diagram.

Those who go to the expense of getting together the parts for this third converter will probably want to finish it off in a becoming fashion. Now that special chasses and cabinets are hard to obtain, our suggestion is that you build it up on the "Little General" chassis and house it in the "Little General" cabinet. Both these items are in relatively good supply and can be made to serve the purpose quite well.

Truly the cabinet is larger than strictly necessary and the chassis has more holes than are required but neither of these factors need cause any worry. There will be no need to apologise for the appearance of the converter as it rests atop your present console.

The accompanying photographs give a good idea as to the layout we have adopted in our experimental model. The gang condenser and dial mount in the same fashion as in the "Little General" receiver, the existing mounting holes being used.

There are two controls, one being the tuning control, the other the change-over switch. As we mentioned earlier, the blank section of the change-over switch may be used to break the heater circuit of the converter valve when the device is not in use.

The "Little General" cabinet has provision for only two controls and is the most suitable for this converter. If possible get the corresponding chassis. The dual-wave chassis will serve, but it will be necesary to drill new holes for the two controls. If you have to use

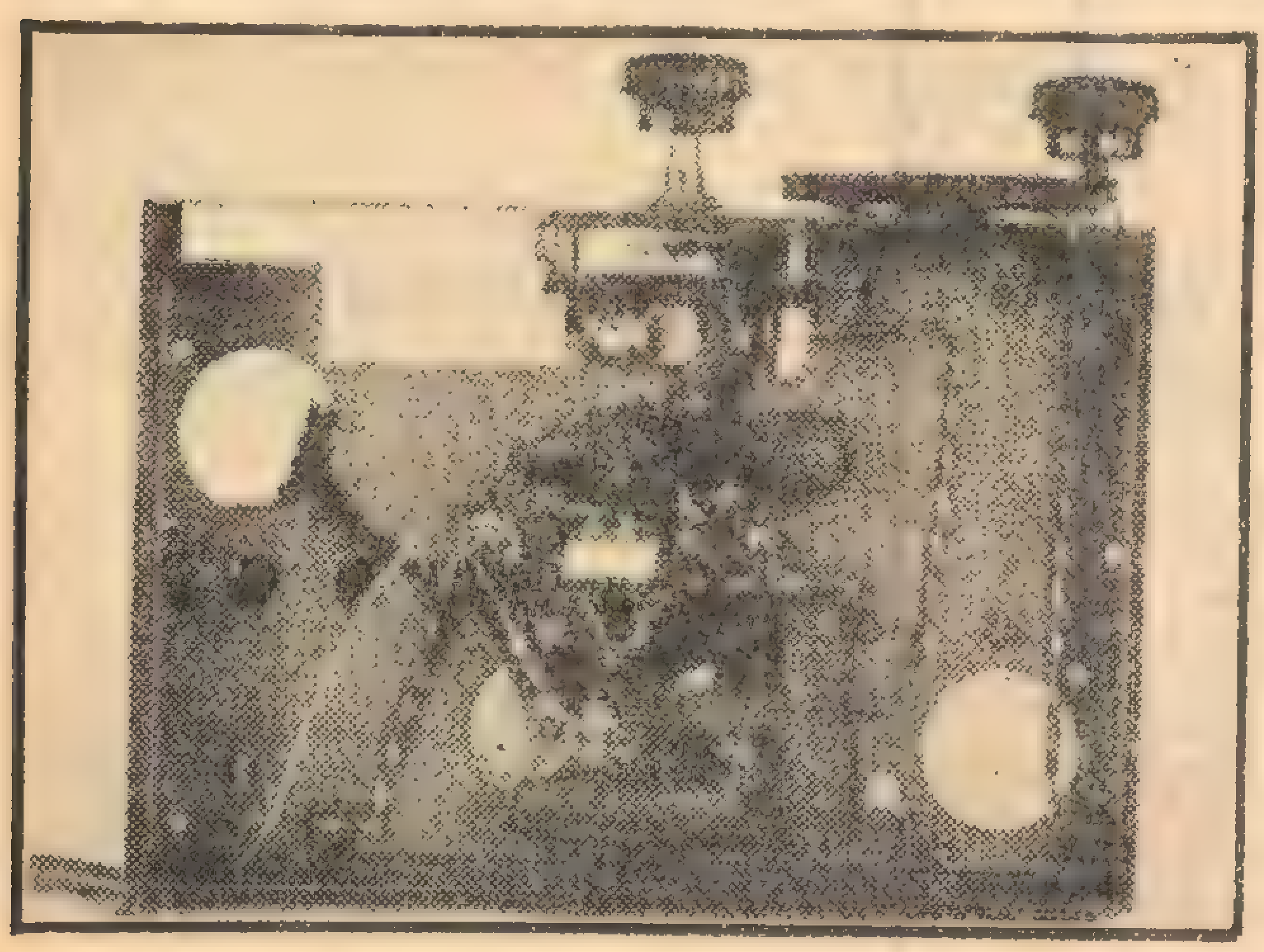


Figure 17. Beneath the chassis, most of the components are grouped around the valve socket. When bringing down the leads from the coil treat them gently to avoid the possibility of breaking off the rather fragile wires. The lead should be covered with small spaghetti tubing.

the cabinet with three holes, you may be able to fit a toggle "off-on" switch to fill the extra hole.

Both coils are mounted above the chassis, the aerial coil being to the front and the oscillator coil to the rear. The front section of the gang is for the aerial tuning, the rear section for the oscillator. The "hot" end of each coil is connected to the appropriate stator plates above the chassis.

The coils are provided with facilities for mounting upright. To mount the coils, we made up two small aluminium strips, about ⅝in. wide and 2½. long, which were bolted across two valve holes. The coils were stood upright in the centre of the strips and the leads taken down beneath the chassis through the spaces at either side of the strips.

MOUNTING SCREWS

By the way, do not use mounting bolts any longer than necessary to mount the coils. If the bolts are too long, they will protrude up the centre of the former and bear against the iron cores when the latter are screwed down.

The output coil is mounted behind the gang condenser in a space originally intended for an I-F transformer. The valve mounts right alongside the oscillator tuning section of the gang condenser.

The filament transformer mounts in the space originally intended for the power transformer.

Terminals for connection to the receiver aerial and earth and for connection to the aerial itself are arranged in suitable holes along the back of the chassis; for the high tension supply, a single lead is brought out.

When the wiring of the converter has been completed, there are a number of adjustments to be made. Begin by connecting the converter to the B/C receiver. There are three connections to be made, namely, the high tension and the connections to the receiver aerial and earth terminals. The latter connections are best made with a short length of shielded wire, using the shielding as the earth connection.

Next connect the mains to the filament transformer primary and see that the heater of the converter valve lights up. Finally connect the aerial to the appropriate terminal of the converter and turn the change-over switch to the short-wave position.

ADJUSTMENTS

Rotate the receiver dial to the high or low frequency end of the broadcast band according to whether you have added the .00025 mfd. condenser to the converter output coil. as per instructions. Now choose a setting for the broadcast receiver dial where there are no signals coming through from broadcast stations. Having found a suitable position, take careful note of the exact setting and leave the dial alone.

Now rotate the converter dial until you hear a signal. Keeping the converter tuned to the signal, try adjusting the output coil trimmer for best results. It should not be necessary to turn the trimmer to either extremity of its adjustment. If you find you have to do this, try another setting for the B/C receiver dial; alternatively, add or subtract parallel capacitance from the plate winding of the converter output coil.

If, perchance, you cannot hear a short-wave signal, the coil may be roughly adjusted by listening to the noise made as you lightly touch the aerial on to the aerial terminal of the converter.

TUNING CIRCUITS

Having adjusted the output coil, the next step is to adjust the tuning circuits. As a beginning, set both trimmers at about the middle of their range Then screw the iron core of the oscillator coil so that the brass rod is protruding about a half-inch. Screw the core in the aerial coil about ¼in. further in than that in the oscillator coil and turn the dial so that the condenser plates are nearly in mesh.

Tune in a short-wave signal and, by simultaneously rocking the converter dial and adjusting the aerial core, find the setting which gives the loudest signals. Alternatively, this adjustment may be made on noise level alone, if that happens to be high enough for the purpose.

Next, turn the converter dial so that the condenser plates are well out of mesh and tune in another short-wave signal. Now proceed to adjust the aerial trimmer for loudest signals. If it has to be screwed right out, screw the oscillator trimmer in a little and try again. If it has to be screwed right in, unscrew the oscillator trimmer until you are able to obtain a peak on the aerial trimmer.

The position of the stations on the dial and the band coverage may be varied a little by simultaneously increasing or decreasing the inductance of the coils and/or the capacitance of the trimmers. Unscrewing the cores out of the coils and unscrewing the trimmers extends the coverage towards the high frequency end of the short-wave band. However, these measures can only be taken as far as considerations of tracking will permit.

IN CONCLUSION

Remember that we are trying to operate the oscillator at a higher frequency than the aerial tuned circuit so that the plug in the oscillator coil should be further out than the plug of the aerial coil. Also peak the trimmers at the high frequency end of the band so that the aerial trimmer is at the minimum setting.

You may find these adjustments a little difficult to understand at first, but you will soon "get the hang of it" when the converter is in operation.

Once things are adjusted to a nicety, you should be able to receive any number of stations at good speaker strength by listening at the appropriate times. For information as to when to listen, turn to the short-wave pages elsewhere in this issue. It should not take you long to identify the various international broadcasting bands.

I.R.E. EXAMINATIONS

The Institution of Radio Engineers (Australia) will be holding its half-yearly examination for admission to the Associate Member and Graduate grades and the Radio Service Technicians examination for the Service Division of the Institution on Saturday, August 1, 1942. Intending candidates are invited to apply to the general secretary, The Institution of Radio Engineers (Australia), Box 3120, GPO, Sydney.

AMERICA'S VAST AIRCRAFT PROGRAMME

(Continued from Page 6)

down and submitted to a test run of twenty-five to thirty hours. Three or four men watch it through a window and read the instruments that record the whole range of its feeling and experiences on coming to life.

At the end of this test run it goes back to the shop and is taken apart, down to the last screw and each piece is examined under a glass to see if anything has happened to it. If not, the engine is assembled again, sent back to the torque room for a short test, then scrubbed and packed and marked for shipment to the plane-maker who is waiting for it.

All this writing has been necessary to give you some idea of how the American aeroplane had evolved and was evolving and how it was being produced. Aeronautical science had gone far beyond popular comprehension. The aircraft industry was a guild a world apart.

On May 26, 1940 the President of the United States spoke of a war programme that would call for 50,000 planes a year. At that moment there were not 50,000 military planes in the whole world. That one nation could produce 50,000 planes had not been imagined.

With the implementing of the plan, the automotive industry came into the picture, rather against the wish, it must be said, of the aeroplane industry. However, they couldn't do the job themselves and the automotive industry had the experience that mass production demanded.

NEW METHODS

One of the best brains of the motor business, Sorenson, production genius of the Ford Motor Co., went to California to inspect the latest aeroplane production practice. Acting along a different line of thought, he immediately discarded the idea in vogue of constructing the shell of the plane and attaching everything to it.

Now the motor car industry is making the plane in sections, all over the country, wing sections, tail sections, nose sections, body sections, and shipping them to the aeroplane builders to be filled with what goes in a plane and then assembled.

Still, that was not the engine. Edsel Ford and Sorenson were not in the least impressed by the aeroplane-engine

(Continued on Page 56)

TRADE NOTES AND NEW RELEASES

"UNIVERSITY" METERS IN THE MAKING

A VISIT TO RADIO EQUIPMENT PTY. LTD.

An operator is shown winding the moving coils for "University" meters. Because of their small size and delicate nature, great care has to be exercised in this operation. The coil winder itself needs to be very smooth and precise in its action.

It was not so very long ago that practically every meter movement used in Australia was imported. Nowadays, thousands of meters are being made locally and fitted into the countless items of radio equipment used by the various defence forces. Well to the forefront in the manufacture of meters is the firm of Radio Equipment Pty. Ltd., of Broadway, Sydney.

ESTABLISHED only six months ago, the growth of their meter section has been remarkable. In that short space of time, the meter output has grown from zero to thousands. In the next six months, it is planned to figure the output in tens of thousands.

An inspection of the radio equipment meter manufacturing section is an interesting experience

First place to see is the machine shop. H-re all necessary mechanical work is carried out and special jigs, required to assist in the assembly of the various components, are manufactured. The bakelite cases are drilled and tapped as necessary. Other components, such as jewel bearing brackets and assembly bridges, are completed.

The meter scale are blanked out and made ready. After completion, the parts are sent to the store for issue to the meter section as required.

The first section of the meter assembly line is devoted to inspection of the various components. All parts such as jewels, pivots, cases, &c., are carefully inspected to see that they come up to standard.

Also in this stage work is carried out on the primary assembly Components, such as the pole pieces for the magnet, are attached to the main assembly bridges, and the jewel bearing brackets for the top and bottom bearings of the meter movement are assembled as complete units. The bottom jewel bearing bracket is attached to the main assembly bridges.

Work is also carried out on the meter cases, including the fitting of terminal bolts, meter glasses and zero buttons. Other operations consist of checking and sizing all the aluminium coil formers before they are issued to the operator responsible for winding coils.

To ensure the best possible accuracy, the many tiny components to be used are carefully inspected under a microscope. Components with any irregularities or flaws are either rejected or sent back for attention, as the case demands.

At this stage in the production, therefore, there are coil formers going to the coil winding operator; meter cases, complete with glasses, zero buttons, terminals, &c., are ready for the final fitting operation at the end of the assembly line; there are the primary assemblies, consisting of the main assembly bridges, to which are attached the magnet pole pieces and also the bottom jewel bearing bracket; the top jewel bearing brackets are ready, as also are the pivots, to which are attached the connection crosses.

WINDING THE COILS

The next process is the winding of the coils for the meters. Different meters have different gauges of wires and different numbers of turns of wire on the coil formers, depending on the sensitivity of the meter itself, and the service to which it is to be placed.

After the coil is wound on the special coil winding machine, the operator, before removing the coil, paints it with a special varnish which holds the turns in position and also helps to impregnate the coil. The coil is then removed and placed in an oven, where the varnish sets to a hard finish.

From here the coil comes along to the next operator, who, by means of a special jig and adhesive cement, attaches the top and bottom pivots to the coil.

This operation calls for a great deal of care in the handling of the jig, otherwise it is possible for the pivots to be off-centre. The operator next in line cleans the insulation covering from the fine wires of the coil and solders them to the connecting crosses which were previously attached to the moving coil. This also is an extremely delicate operation.

The hairsprings differ in type, depending upon the meter for which the coil is intended. Special jigs are used to enable the operator to attach the hairsprings in a uniform manner.

Fitting the tiny hairsprings is a job for sensitive fingers. Faulty fitting at this stage of the work would result in a meter with tracking errors over the scale.

Each completed movement is very carefully checked before fitting into the case, preparatory to shipping. The check takes in such things as the general appearance, balance of the pointer, freedom of movement and finally a direct check against a standard instrument.

Assembling a meter is indeed a delicate task. Note how the meter is held in a special clamp. The air must be absolutely free from dust and fluff if "sticking" troubles are to be avoided.

The next stage in the construction consists of fitting the primary assemblies with the moving coil. The same operator also balances the meter and attaches a graduated scale to the assembly. The magnet is fitted and the meter is adjusted for sensitivity, the operator checking the movement against a standard attached to his bench.

This stage of the work is one of the most important in the construction of the meter. The delicate operation of balancing and also adjusting the jewel bearings so that they enable the moving coil to move freely, without being sluggish, calls for a high degree of skill. It is also absolutely essential that any particles of dust or fluff be kept from the meter movement.

ABSOLUTE CLEANLINESS

Most of the "sticking" troubles associated with meters are caused by tiny particles of dust or very fine tendrils of a hairlike nature, which are practically invisible to the human eye. The operator is provided with magnifying eye-glasses and other aids which enable him to detect anything likely to impair the efficiency of a meter.

Naturally, considerable care has to be exercised to keep the air in the factory as clean as possible and to avoid having meter movements lying about for longer than is absolutely necessary.

The meter then goes along the next process, which consists of fitting the meter in its case. Also at this stage any necessary internal shunts or multipliers are attached. The work consists only of fitting, and no other adjustments are carried out, because the meter has already been adjusted for sensitivity, and the shunts and multipliers are carefully selected beforehand, so that they are known to be substantially correct.

The meter now arrives at its final stage. The operator checks the meter thoroughly so that it is quite up to standard as far as appearance, &c., is concerned. The meter must then pass tests for balance, movement and accuracy, which tests are carried out from a standard instrument kept only for this purpose.

The standard instrument is frequently checked against absolute standards. Any slight adjustment which is needed is carried out, and the meter is then finally screwed up, and sent along to the shipping department.

The normal percentage of accuracy to which the meter must comply is plus or minus 2 per cent. at full scale deflection of the needle, unless special tolerances are required for some particular purpose. However, the operator takes care to see that its percentage of accuracy is considerably within these limits, and it is usually within the margin of plus or minus 1 per cent.

Once the meter has reached the shipping stage, it is packed in a specially constructed box which serves to protect it on its journey to anywhere in the Commonwealth.

★

Meter movements to be included in test equipment are tested as units and then as a part of the completed item of equipment. "University" test gear is finding its place not only in factories and service shops but in units charged with the responsibility of maintaining the radio equipment of the defence forces.

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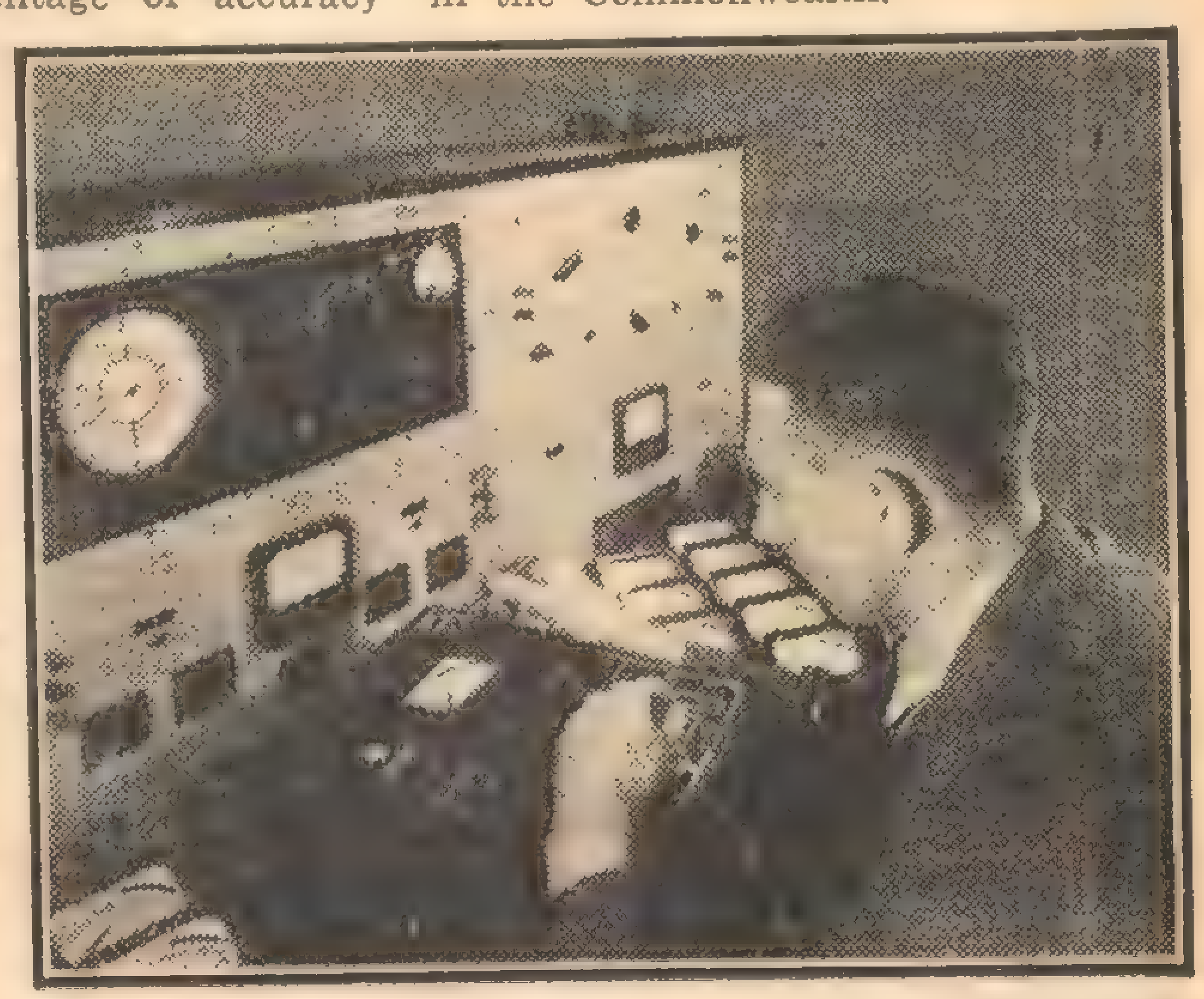

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Volume III. 1939 Australian Receivers. Limp cover, 12/6 (post 8d); Cloth cover, 15/- (post 8d).

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Radio Operating, Questions and Answers. By Arthur R. Nilson and J. L. Hornung. A famous book for those preparing to take radio operator licence examinations. 415 pages, giving nearly 1300 questions on radio communications — theory, apparatus, circuits, laws and regulations, etc., together with full, correct answers for review and study. 20/- (post 9d).

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Arithmetic of Alternating Currents. Containing 50 worked examples and 182 exercises. By E. H. Crapper. 208 pages. 8/3 (post 4d).

Elementary Lessons In Electricity and Magnetism. By S. P. Thompson. 744 pages, with over 370 illustrations. 11/- (post 6d).

Admiralty Handbook of Wireless Telegraphy, 1938. Volume I., Magnetism and Electricity. Volume II., Wireless Telegraphy Theory. Two vols., 18/9 (post 2/-). Sold separately: **Volume I.,** 7/6 (post 10d). **Volume II.,** 11/3 (post 1/4).

Elementary Electrical Engineering. By Albert E. Clayton, D.Sc. Second edition. 473 pages, with 318 diagrams. 17/- (post 7d).

Handbook For Wireless Operators. P.M.G.'s Handbook on working installations. Licensed by His Majesty's Postmaster-General. Revised 1938. 1/6 (post 3d).

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THE DESIGN OF D-C MAINS RECEIVERS

AN ARTICLE BY THE TECHNICAL EDITOR

Many, indeed, have been the requests for us to publish data on the design and construction of d-c mains receivers. We have never been keen on doing this, because we do not believe the construction of such receivers to be a safe proposition for inexperienced homebuilders. The following article has been prepared for the benefit of those with a fairly extensive knoweldge of radio construction. If you are unable to follow the discussion or to work from the theoretical circuit diagram at the end of the article, take our considered advice and don't attempt the construction of a d-c mains receiver.

ALTHOUGH the vast majority of power installations in Australia are a-c, there are still quite a lot of towns and localities in which the power supply is d-c. Most of the ships around our coast have d-c installations. The ordinary domestic appliances, such as lamps, toasters, radiators, etc., work equally well with a-c or d-c, but not so with radio receivers or the many household devices incorporating an electric motor.

Direct current—or d-c for short—is so called because it flows steadily in the one direction around the electrical circuit. Alternating current, on the other hand, is generated in such a way that the direction of flow is continually changing.

The electric current supplied by batteries of all descriptions is direct current, or d-c. Direct current may also be generated by rotary machines, varying in size from the comparatively small generator in an automobile to the very large generators seen in power stations.

The fact that batteries—and in particular storage batteries—deliver only direct current explains why d-c is particularly suitable for certain installations, as, for example, in automobiles and other vehicles, for home lighting, for farm power, and even for small townships.

In such cases, it is frequently neither possible nor convenient to have the generator in continuous operation, although it is obviously desirable to have power available at all times

Provided that one is content to us d-c, it is possible to arrange a storage battery system in conjunction with the generator, so that, when the latter is not in operation, any power required may be drawn from the battery bank.

In larger installations, storage batteries cease to be a proposition, and it becomes possible to maintain one or more generators in continuous operation, having others ready to assist during peak periods, and to permit overhaul of plant.

The installations where the generators have to be kept in continuous operation, it becomes possible for the engineers to instal machines which will deliver alternating instead of direct current. Of course, the engineers responsible have to take a wide view of things, and there may be considerations which make it necessary to adhere to a d-c installation.

PRESENT TREND

However, the present general trend, not only in Australia but in most countries of the world, is towards a-c installations and the elimination of small independent generating plants in favor of large central plants supplying large sections of each State through far-reaching cable networks.

As yet, the long fingers of the transmission lines have not reached out as far as they will ultimately go. There are still plenty of places where d-c power installations, made in the light of earlier practice and ideas, have yet to be replaced.

It is not as easy as might be imagined to switch over a whole town or city from alternating to direct current. The engineers have to face up to a lot of problems, not the least of which is the hundreds, or perhaps thousands, of electric motors, in one form or another, which may have to be rebuilt or scrapped as a result of the changeover.

All this may seemingly have little to do with the subject on hand, but it may help to calm the ire and frustration which our readers experience when they find themselves in a d-c area.

ADVANTAGE OF A-C

When many of these installations were made, electricity had only limited application, and all-electric radio receivers were not even contemplated. Indeed, any power is better than no power—particularly in these days when country people find it hard to get B batteries, and harder still to get vibrator units.

The particular advantage of an a-c power installation is that the voltage may be stepped up or down to meet special requirements by a simple or non-mechanical device, which we know very well as a transformer.

If we want a low voltage supply to operate a trouble lamp or electric bell, or, again, a very high voltage to operate a neon sign, all that is necessary is to obtain a transformer, delivering the correct voltage and current.

Not being a mechanical device, a transformer does not require maintenance, and in operation it is about 80 or 90 per cent. efficient.

In the case of d-c installations, different voltages can only be obtained by means of dropping resistors, which are wasteful of power, or by mechanical transformation, involving motors and generators; these are expensive, and often inefficient, and require plenty of attention.

Figure 1 shows the circuit diagram of a typical receiver for operation from a-c mains. For those of you who may wish to know, it is actually the "1941 Dual-Wave Advance" receiver, described

(Continued on Next Page)

CIRCUIT OF A TYPICAL FIVE-VALVE A-C RECEIVER

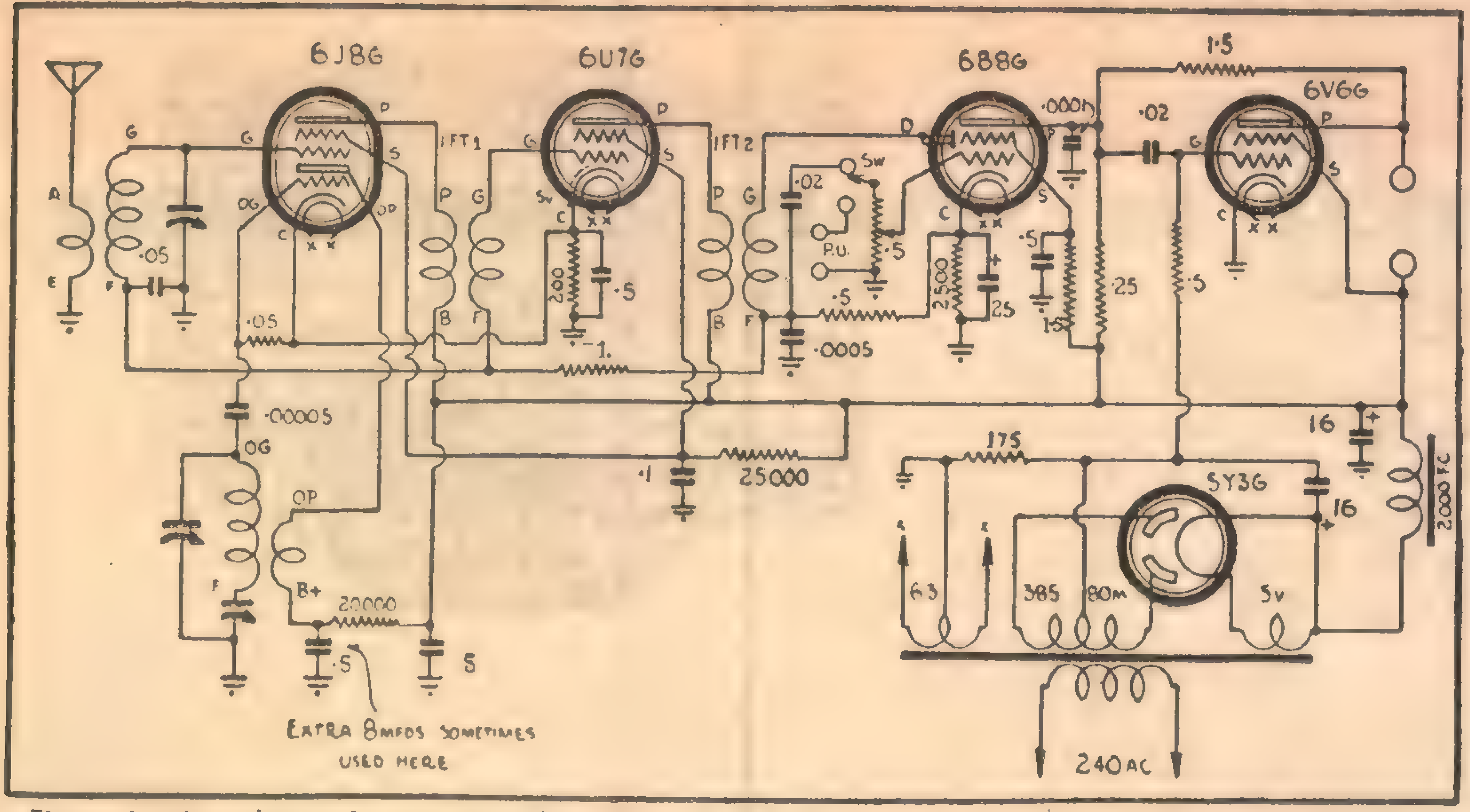

Figure 1. As a basis of comparison, here is the circuit diagram of a typical a-c mains receiver. Note that the only connection of the power mains in the chassis is to the primary winding of the power transformer. There is no electrical connection to the chasis or to any other part of the electrical circuit. The chassis assumes no particular potential with respect to earth and is therefore quite safe to handle.

in the August, 1941, issue and reprinted in the Christmas issue, 1941-42.

Inspection of the circuit will quickly reveal that the only connection from the power mains is to the primary winding on the power transformer. There is absolutely no electrical connection between the power mains and the chassis, or to any other portion of the electrical circuit.

Thus, the chassis or other parts of the circuit can never become "alive" at the potential of the mains, except in the rather remote possibility of a breakdown somewhere in the insulation or in the event of an incorrect connection being made. This is true of all ordinary a-c mains receivers.

On odd occasions, when one is connecting an earth wire to an a-c mains receiver, a very small spark may be seen. On other occasions, when one happens to touch an unearthed chassis with the face or the tender part of the forearm, a slight tingling sensation is noticed.

These things do not necessarily indicate that the chassis is "alive," but may simply be the result of accumulated charges or capacitive and inductive effects.

BYPASS CONDENSERS

A few receiver manufacturers, for one reason and another, were in the habit of bypassing each side of the mains to the chassis of a receiver by means of small condensers. Such a chassis is capable of giving one a definite "kick" if it is touched while one is holding an earth wire. However, it is doubtful whether the shock would be sufficient to cause injury, except where one of the condensers became short-circuited.

Referring again to the circuit diagram, you will note that the power transformer is fitted with a number of secondary windings, which have no electrical connection whatever to the primary winding.

The first of these is a 6.3 volt winding intended to supply the heaters of the various valves. These heaters are simply connected in parallel across the winding. The total current drain, in this case, is 1.35 amps, which is well within the capabilities of the usual 6.3 volt winding fitted to standard power transformers.

CURRENT DRAIN

In addition to the valve heaters, there may be up to four dial lights connected across the winding. Apart from seeing to it that the winding is not called upon to supply more current than it is capable of, we do not have to worry about the current drain of the various units. It is only necessary to see that they are supplied with the correct voltage.

If the valves require more than one filament voltage, or if the total current drain is higher than can conveniently be handled by a single winding, additional filament windings may be provided.

In order to prevent hum and to reduce interstage coupling, the heater windings are usually "earthed" to the chassis.

A separate heater winding is provided for the filament of the rectifier, which, in this case, is a 5Y3-G, requiring a heater voltage of 5.0 volts. This winding is at a high d-c potential with respect to earth and must not be connected thereto.

The remaining winding on the power transformer is the high-tension secondary winding, supplying the plates of the rectifier valve. This winding delivers 385 volts either side of the centre-tap, so that the voltage overall is 780 volts RMS.

This is indeed a very high voltage and needs to be treated with respect. However, the very appearance of the power transformer panel is sufficient to warn even the least technical person to keep their fingers clear. There are only two wires connected to the high-tension secondary and, in practice, it is very seldom that an experimenter gets a shock from this source.

NOT VERY DANGEROUS

One can obtain some very spectacular sparks from the B-plus line in an a-c receiver, but, to borrow a phrase, the bark is worse than the bite. The spark is really the discharge of the filter condensers and the regulation of the power supply is usually so poor that the imposition of a heavy load immediately causes the voltage to drop.

Even so, the shock from the B-plus line might be serious if it were received under certain unfavorable conditions. Fortunately, one is usually on the lookout, when prodding around under a chassis in operation, and the shocks one receives, if any, are not severe and are of short duration.

These facts probably explain why fatalities, or even serious injuries, are practically unheard of in connection with ordinary mains receivers.

The dangerous shocks are those which one receives unexpectedly, and by making firm and definite contact with the two sides of a high voltage electrical circuit.

Having now been reminded of some of the characteristics of ordinary a-c mains receivers, we can proceed to consider the special problems associated with receivers designed for operation from d-c mains.

Pursuing our theme of "safety first," let us first consider the matter of the high tension voltage.

In an ordinary a-c receiver, it is usual to find a high tension winding on the power transformer delivering at least

(Continued on Page 37)

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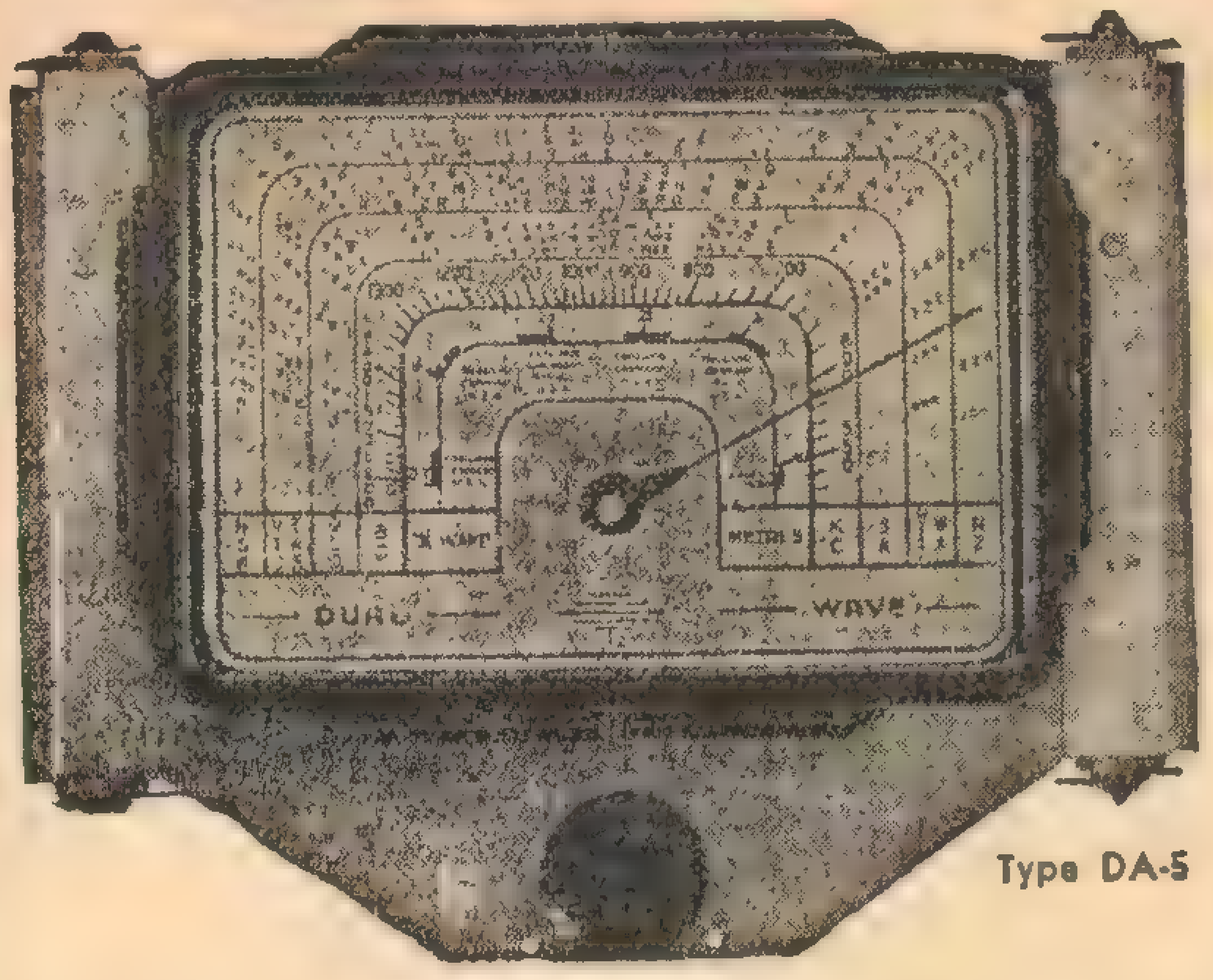

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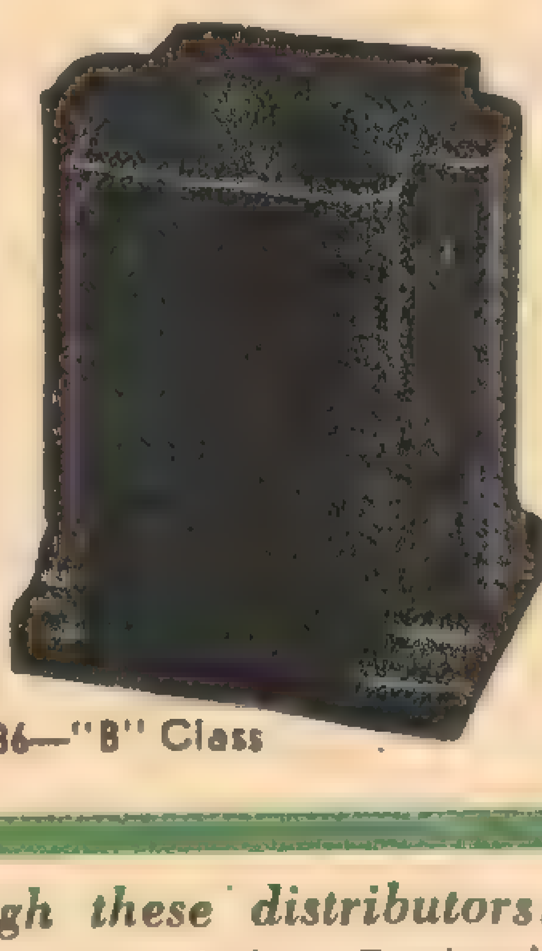

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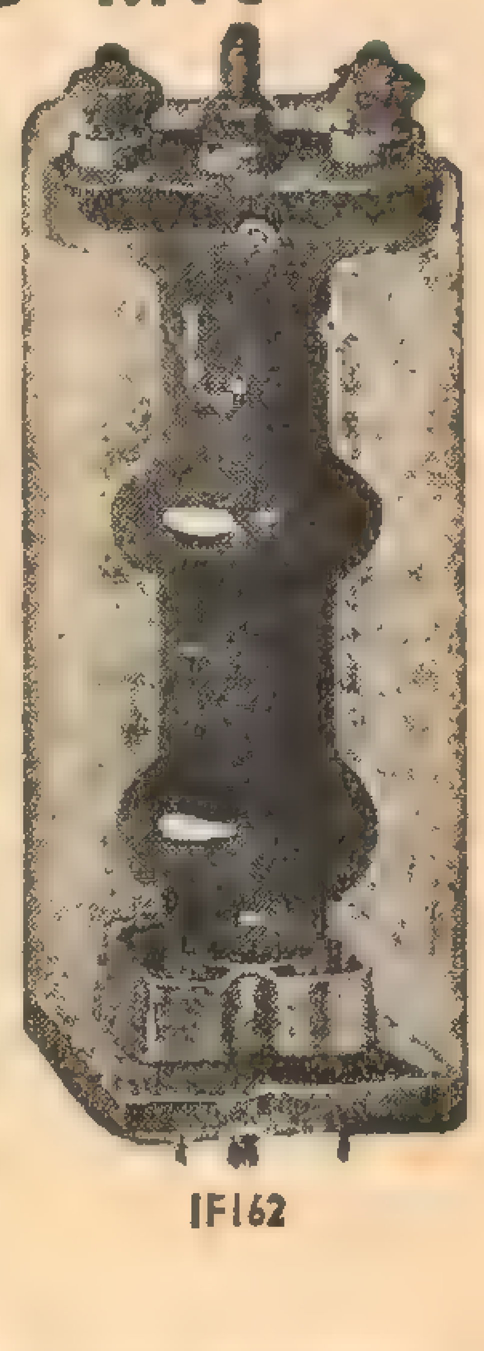

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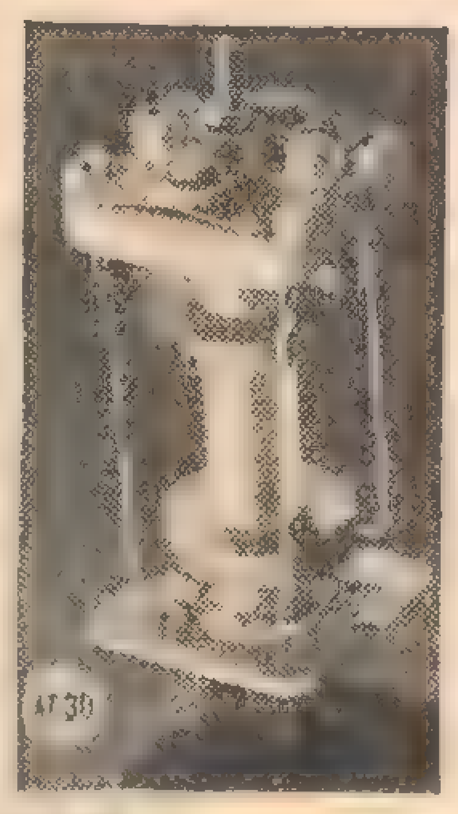

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780 volts RMS. At the output of the rectifier, it is usual to find a d-c potential of about 400 volts, and, at the output of the filter system, seldom less than 250 volts.

IMPORTANT DIFFERENCE

In a d-c mains receiver, the highest voltage one can find is the mains voltage, which is usually 250 volts.

However, there is an important difference. In the case of the a-c mains receiver, the isolating action of the power transformer allows the power supply to be entirely self-contained, and the chassis, or, for that matter, any other portion of the receiver, does not have to be at any particular potential with respect to earth or to the power mains circuit.

The chassis of the receiver can be earthed or left floating as desired, and it is, therefore, unnecessary to take any particular precautions to prevent accidental contact with the chassis.

In the case of a d-c mains receiver it is impossible to use a power transformer, and it is likewise impossible to isolate the mains from the electrical circuit of the receiver.

CANNOT BE ISOLATED

Whether we like it or not, the negative side of the mains has ultimately to make electrical contact with the cathodes of the valves and the positive side to make electrical contact with the plates and screens.

As one side of the supply mains are always connected to earth, it is inevitable that the chassis and/or portions of the electrical circuit of the receiver assume a definite potential with respect to earth.

Therefore, if anyone, inadvertently or otherwise, happens to be in contact with an earthed object and touches a live portion of the circuit, the full mains voltage is received—without excuse or adulteration.

Owing to the method of transmission there is no standard method of earthing a d-c power circuit. In some localities it will be found that the negative side of the mains are at earth potential. Elsewhere, the positive side may be earthed.

MAINS ARE EARTHED

If the negative side of the mains are earthed, the receiver will operate in the usual fashion with the cathodes at or near earth potential and the plate positive with respect to earth.

On the other hand, if the positive main is earthed, the plates in the receiver will have to be at about earth potential and the cathodes of the valves negative with respect to earth by an amount equal to the mains voltage.

The construction of a d-c receiver may be approached in two ways. The first method—and perhaps the simplest—is to connect the negative side of the mains directly to the chassis, also returning all cathode circuits and bypass condensers to the chassis in the usual fashion. The positive side of the mains is simply passed through the filter system and applied to the plates and screens as necessary.

Provided the negative side of the mains is earthed, and provided the power plug is inserted into the socket in the correct manner, the chassis will be at earth potential and could, in fact, be directly earthed with an external earth wire.

A TYPICAL A-C POWER SUPPLY CIRCUIT

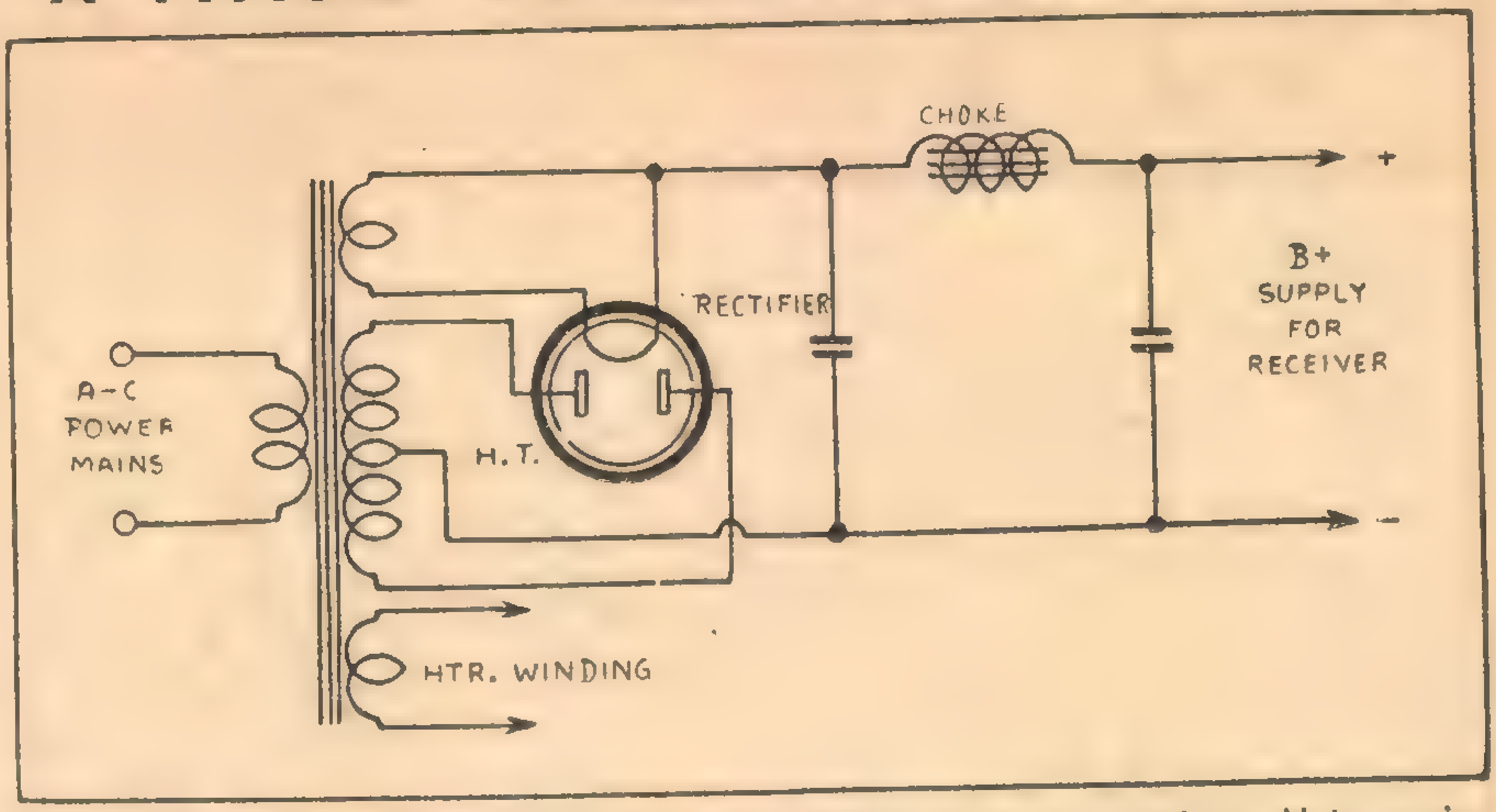

Figure 2. A typical circuit for the power supply of an a-c receiver. Note again how the mains are totally isolated from the rest of the circuit. Note also how that the high tension supply is entirely self-contained, permitting the negative side to be earthed directly or through a resistor to provide a back-bias voltage. The valve heaters are supplied in parallel from suitable secondary windings, which are independent of the rest of the circuit.

SOURCE OF DANGER

However, one can guarantee neither state of affairs. If the power plug should happen to be inserted the wrong way round, the chassis naturally assumes potential above earth of plus 250 volts, and becomes a death-trap for the unwary.

If an earth wire is connected at the time the plug is reversed, there is a good chance of burning out, not only the fuses, but portion of the electrical circuit as well. This statement is not exaggerated—we have seen it happen on more than one occasion.

In the other eventuality of the positive side of the mains being earthed, the only way the receiver will operate at all is with the chassis at a potential of -250 volts with respect to earth. Again, the alternative is a death-trap or blown fuses.

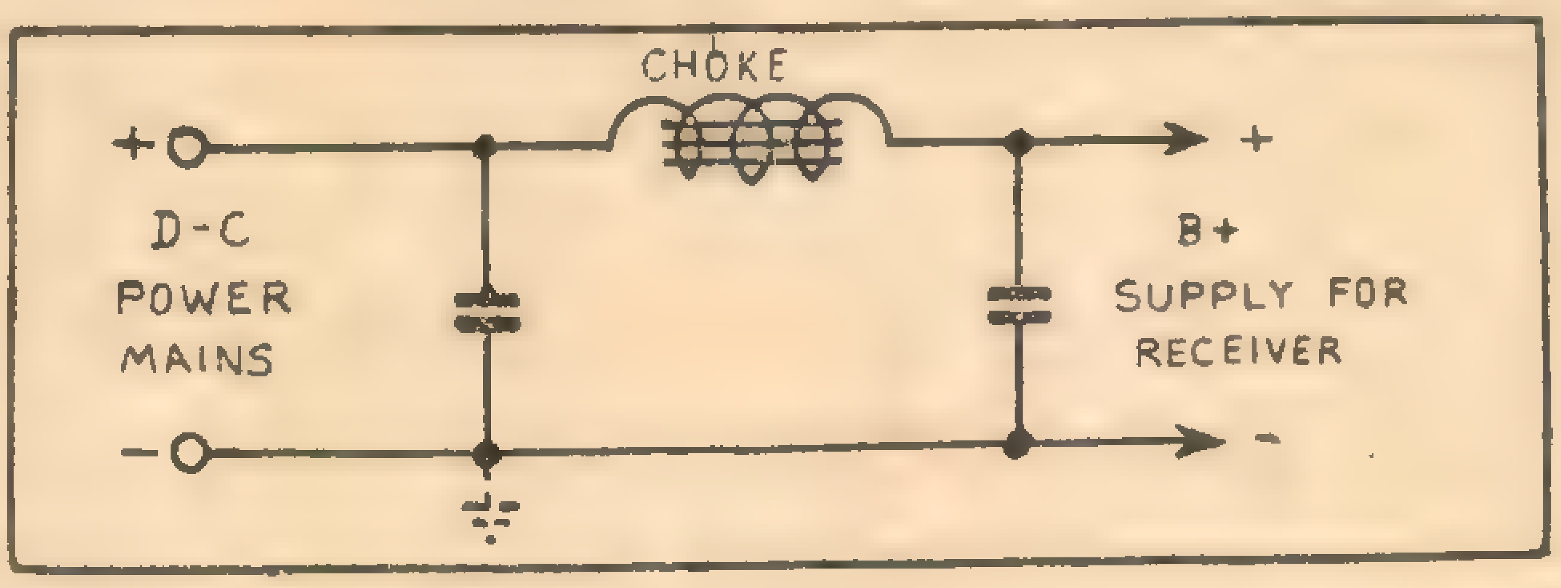

Figure 3. In the case of a d-c receiver, it is not possible to use a power transformer and the high tension supply for the valves must, of necessity, have direct electrical connection to the power mains. The same is true of the heater circuit. The implications of this are explained in the text.

A further danger—and this has been responsible for more than one death—is that of rendering the aerial "alive." It follows that, if the aerial is connected ultimately to the chassis, and the latter is above or below earth potential, the same potential will be present on the aerial wire, and, of course, the lead-in.

To avoid the attendant dangers of this method of construction, certain precautions are absolutely essential. In fact, there are certain laws and regulations dealing with the subject.

NECESSARY PRECAUTIONS

The first requirement is that the chassis should be totally enclosed, preferably by a non-conducting material, so that accidental contact with the chassis, speaker, or bare leads is impossible. This boils down to having the receiver housed in a wooden or bakelite cabinet with a hinged back.

Further, the grub-screws in the knobs must be well down in the hole, and the hole itself filled with wax or other similar material.

The hinged back of the cabinet should be fitted with some switching device which will break both power leads immediately the door is opened. It is insufficient to break a single lead, since there may still be a potential on the chassis.

An easy method of achieving the automatic switching is to obtain a bakelite junction unit, fitting one portion to the hinged back and one to the inside of the cabinet, so that the two come together and make contact when the back is closed.

In particular, the female portion of the plug, carrying the mains voltage, is recessed into the edge of the back. The male portion, connected to receiver, is screwed to the inside of the cabinet. All that is necessary is to remove the usual assembly nut and bolt in each portion and to drive a light gauge wood screw through the vacant hole into the woodwork.

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TAKE NO RISKS WITH A D-C RECEIVER

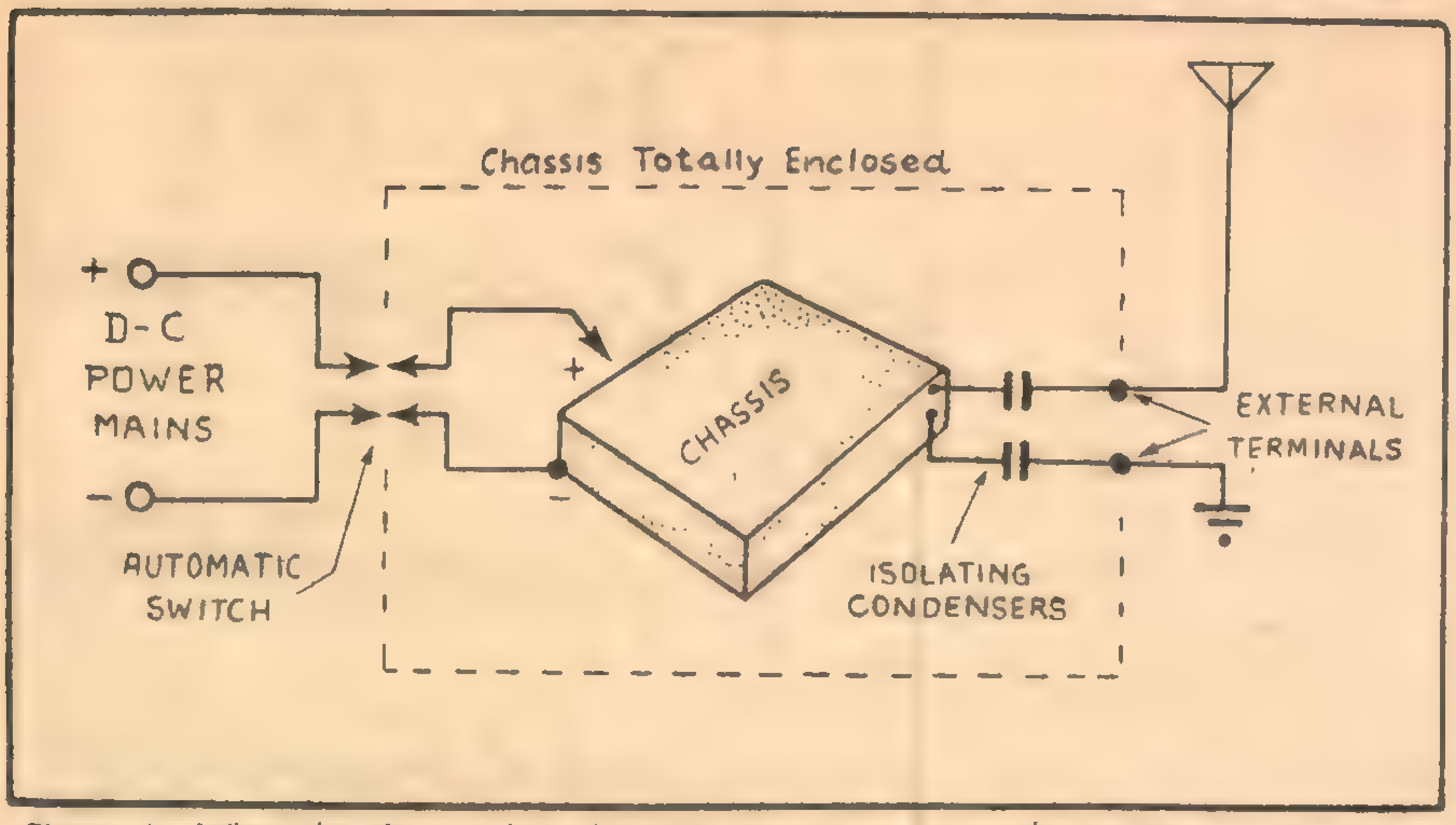

Figure 4. When the chassis of the receiver is used as the return for the negative side of the mains, it is essential to guard against anyone making accidental contact with it. The back of the cabinet should be fitted with a hinged back and a switch to break the circuit when the back is opened. Isolating condensers should be included in series with the aerial and earth leads.

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Be sure to anchor the power cord to the door firmly with suitable staples. The natural urge is to pull open the door by means of the cord, and it is an easy matter to pull the live lead right out of the plug.

The remaining safety measure is to fit an aerial and earth terminal to the outside of the cabinet, connecting them to the respective terminals on the chassis proper through condensers of between .01 mfd. and 0.1 mfd. These condensers will need to be of good quality to minimise the chance of breakdown.

All these precautions may sound rather involved and elaborate, but they are very necessary if the receiver is to be made completely safe.

CARE DURING TESTS

It goes without saying that the utmost caution must be exercised in the testing of the receiver, since this must be carried out, without protection, on the test bench. The first step should be to make sure which side of the mains is at earth potential. This can be done quite easily with a voltmeter, by connecting it between an earth connection and either side of the mains alternatively.

With a continuity meter, pick out the positive and negative leads in the power cord, so that the receiver may be connected to the power in the correct fashion. Before connecting the receiver, however, clear all the debris off the bench, so that the receiver is in the clear. Treat the receiver with the utmost respect until you have ascertained that the chassis is not alive.

In the event of the chassis having to be at a potential of -250 volts with respect to earth, stand on a dry bag or mat, or, better still, sit on a wooden stool. Don't let your hands stray towards an earth wire or to test instruments which may be earthed.

Before making any alterations to the circuit, disconnect the receiver altogether from the power. This is particularly necessary if you have to use an electric soldering iron.

BEWARE OF ARCS

Try and avoid, at all costs, shorting B-plus to the chassis. Remember, you are no longer dealing in milliamps, but in as many amps as the fuses will pass before blowing. An accidental short with a screw-driver or lining tool may start an arc, which will easily burn out a component before you can switch off the power.

When you come to connecting the aerial and earth or test leads, be very careful and use blocking condensers wherever possible. It's bad enough to blow the fuses. It is worse to damage the receiver or your test gear. It is worse still to damage yourself!

An alternative method of constructing a d-c mains receiver is set out in the following paragraphs. This method reduces the danger of shock by accidental contact with the chassis.

The basic idea is to avoid connecting the negative side of the mains to the chassis, connection being made instead to an insulated busbar located in a convenient position under the chassis.

The chassis is assembled in the usual fashion, coil cans, i-f transformers, gang condensers, and other exposed metal components being bolted to the chassis. The "earth" terminal and the "cold" pick-up terminal, if any, are also connected directly to the metal chassis.

INSULATED BUSBAR

Underneath the chassis, and supported rigidly on insulated pillars, a heavy busbar is installed. The insulation of this busbar is most important.

To this busbar is connected the negative side of the power mains, and all other direct current circuits, normally returning to B-minus.

In particular, these negative returns would include the high tension filter condensers, all cathode bias resistors, all grid resistors, the diode load, the AVC network, and, finally, the heater circuit, to which reference has yet to be made.

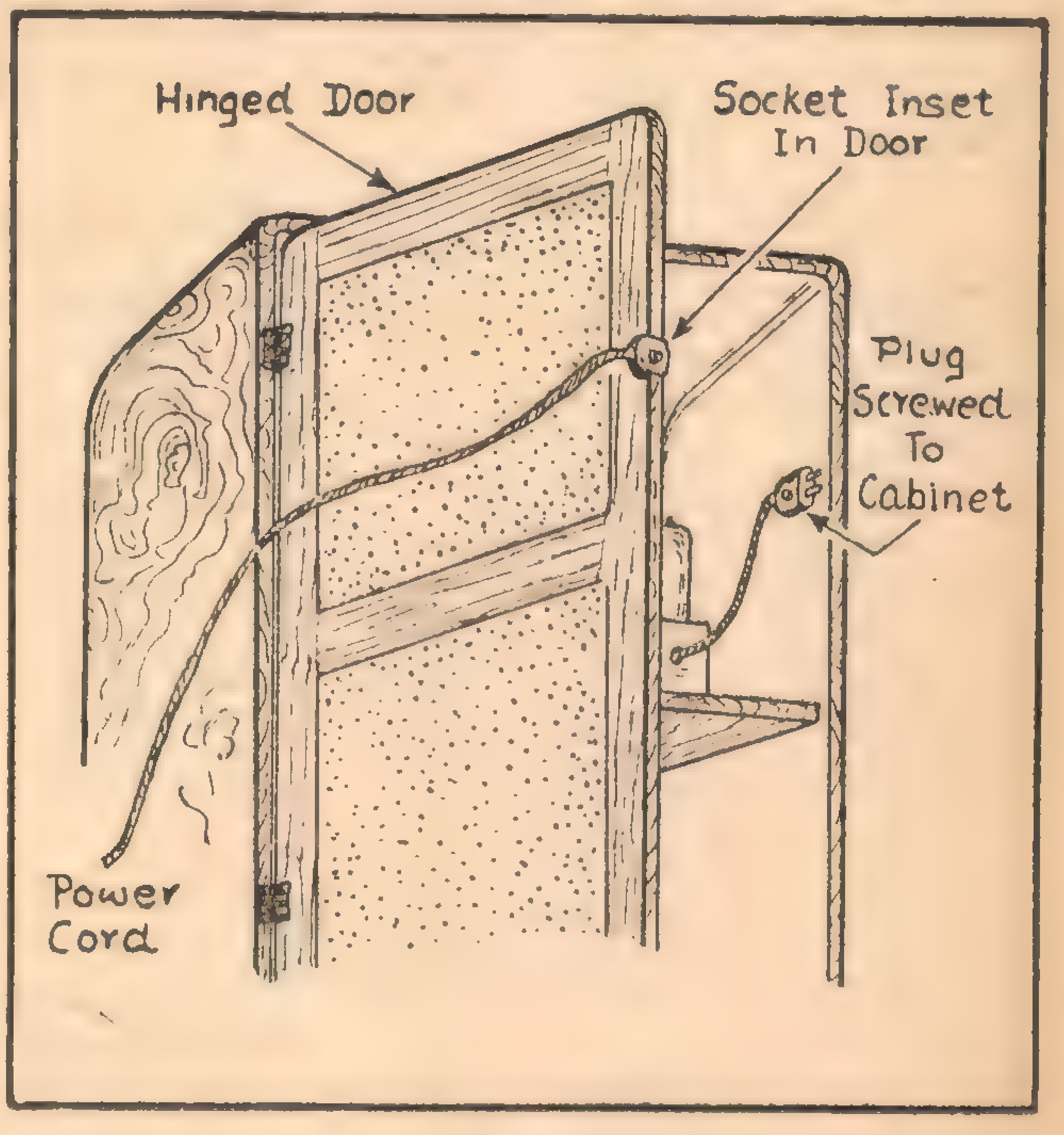
In other words, the chassis and other exposed metal parts must be completely isolated from the power mains; when the receiver is completed an ohmmeter should register a complete open circuit when connected between the chassis and either side of the mains.

In order to maintain the effectiveness of the chassis and of the cans as a shielding medium, it is necessary to connect a large bypass condenser between the chassis and the negative busbar. This condenser should have a capacitance of between 2.0 and 4.0 mfd., and should be of reliable make, with a d-c working voltage rating of at least 400 volts.

Should this isolating condenser break down the chassis may suddenly become alive, or the fuses may be blown.

This method of construction raises

Figure 5. Illustrating one method of enclosing the chassis of a d-c mains receiver. A panel door, fashioned from plywood or masonite, is hinged to the rear of the cabinet. The two sections of a line plug are mounted, as shown, so that contact is made when the door is closed and broken when it is opened. External aerial and earth terminals may also be fitted to the outside of the door and connected to the terminals on the receiver through blocking condensers.



some interesting problems in regard to the bypass condensers. In the usual receiver the various bypass condensers are connected to the chassis, which also serves as a return for B-minus.

When B-minus is insulated from the chassis the problem arises as to whether the condensers should be returned to the chassis or to B-minus.

MAIN FILTER CONDENSERS

In regard to the main filter condensers and high tension decoupling condensers, there is little argument. To return these condensers to the chassis would mean that their effective capacitance would be reduced, since they would then be in series with the d-c blocking condenser between the chassis and B-minus. Furthermore, this latter d-c blocking condenser would be common to all filter circuits, which might result in instability.

For this reason, if for no other, the filter condensers should not be of the electrolytic can type using the can as the negative connection. It would obviously defeat the whole purpose of the scheme if the chassis were at earth potential and the electrolytic cans, duly insulated from the chassis, at the potential of the mains. There is another reason why any type of electrolytic condenser is undesirable, which reason will be discussed presently.

A.V.C. CONDENSERS

With regard to the screen, cathode and plate bypass condensers, these may also be connected to the negative busbar, although they are less important than the filter condensers. The same is true of the bypass condensers for the oscillator anode and for certain portions of the AVC line.

In the case of AVC bypass condensers for the tuned circuits at signal frequency, there is some doubt. If there are two such bypass condensers and both are returned to B-minus, the main d-c blocking condenser will be common to both tuned circuits.

To check this point, it is merely necessary to trace out the tuned input circuits, following through the coils, the AVC bypass condensers and the tuning gang, the latter with its rotors necessarily at earth potential.

If both AVC condensers are connected to the chassis, then the d-c blocking condenser becomes an impedance common to the respective input circuits between the grids and cathodes. This may or may not lead to difficulty with instability.

A GENERAL RULE

As a general rule, when adopting the method of construction under discussion, it is a good plan to return all bypass condensers to the negative busbar and to use as large a condenser as possible between the busbar and the chassis.

In the event of the receiver proving unstable, it is then time enough to experiment with the various condensers to see whether the trouble can be eliminated by returning one or more of them to the chassis. In this regard, preference should be given to those condensers not connected with the high tension supply.

This renders the possibility of a breakdown less likely. If a breakdown does occur, the trouble is localised and is less likely to result either in the chassis becoming alive or in a direct short-circuit of the power mains through the filter system.

For the sake of those who may wish to build up a d-c mains receiver, we have drawn out the typical circuit showing all the connections returned to a negative busbar. The circuit is, therefore, suitable for construction along the lines just discussed.

If desired, the alternative method of construction may be adopted, simply using the chassis as the negative return and taking due precautions to see that it is rendered inaccessible to prying fingers.

H.T. FILTERING

Having now disposed of the more or less mechanical side of the question, we can proceed to discuss the circuit problems.

Although the mains voltage is nominally d-c, there may be a considerable amount of ripple present, depending, of course, on the particular installation. The ripple may easily be sufficient to set up a troublesome hum in the output, and, for this reason, it is as well to incorporate a certain amount of high tension filtering.

This need not be as effective as that normally used in an a-c set and may simply consist of a choke or field coil followed by a filter condenser. Some d-c receivers incorporate both, but, as often as not, this is to allow the full available voltage to be applied to the early stages in the receiver.

For the filter condensers, electrolytic condensers are not very suitable. Certainly, they are perfectly satisfactory when the receiver is connected to the mains in the correct fashion. However, if the power plug is inserted wrongly—which is quite easily done—the filter condensers are subjected to a reverse voltage and become virtual short-circuits across the line, with obvious results.

PAPER CONDENSERS

The use of paper condensers avoids this difficulty, although these are more expensive and not available with the same capacity ratings. Fortunately, one can usually get hold of a few 2 mfd. or 4 mfd. condensers from old receivers, which serve the purpose admirably.

As a general rule, d-c power mains are famous—or should one say infamous—for the amount of radio interference they carry. This is probably due, firstly, to the fact that most d-c installations are old; secondly, to the number of brushes and commutators in the various appliances; and, thirdly, to the tendency for d-c to arc badly across any intermittent or poor contacts.

To prevent the introduction of such interference directly into the circuits of the receiver, it is a wise plan to incorporate an r-f filter in series with the mains.

In areas where the interference is high, it is as well to build up a self-contained line filter unit, quite distinct from the chassis of the receiver. This unit should be built up in a metal box provided with an earth terminal.

Such a line filter would contain a pair

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of r-f chokes, one in each leg of the mains, and bypassed at either end with good quality condensers of capacitance between 0.1 and .01 mfd.

The r-f chokes are required to carry the entire current drain on the receiver, which is likely to be about 0.4 amp., or 400 milliamps. They must not overheat nor introduce too much d-c voltage drop.

It may be possible to procure suitable honeycomb wound chokes commercially. Failing that, they may be wound up in the form of solenoids, with something like 24 gauge wire. The actual details are not critical the general idea being to get as much inductance as possible without running into trouble with voltage drop and overheating and without introducing too much parallel capacitance. Note that a single layer winding is usually the most satisfactory.

For the line filter unit to be effective, the metal case forming the return for the bypass condensers must be properly earthed to a water pipe or some other effective earth.

In many cases such an elaborate line filter is unnecessary, and it is quite sufficient to include a simple r-f filter at the point where the mains enter the chassis.

ALTERNATIVE CONSTRUCTION

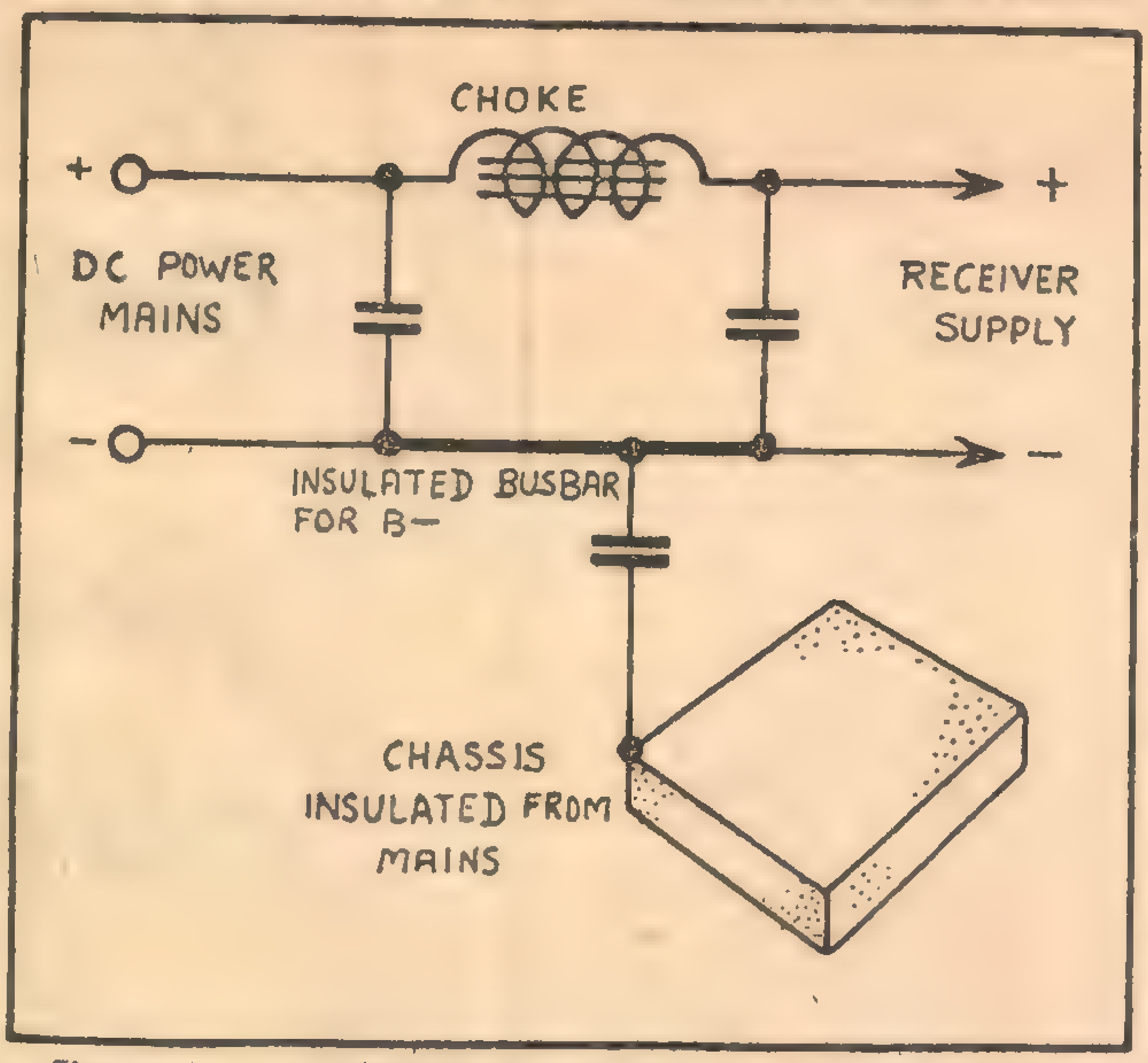

Figure 6. An alternative method of constructing a d-c mains receiver is to return the negative side of the mains and all d-c circuits to an insulated busbar beneath the chassis and bypassed to the chassis through a large paper condenser. This obviates the necessity for enclosing the chassis although there are certain complications in regard to the circuit, as explained in the text.

The installation of an r-f filter network in the power supply may help matters considerably, although it obviously has no value in reducing interference picked up in the aerial. Therefore, in bad localities the line filter arrangement should be supported by some form of noise reducing aerial system.

SIMPLE FILTER

In this case, the negative side of the mains is connected directly to the negative return in the receiver, being either the chassis itself or an insulated busbar, according to the method of construction adopted.

The positive side of the mains is taken through a single heavy duty r-f choke, bypassed to the chassis at either end with small condensers. Thence the current flowing is divided, part flowing direct to the heater supply network and part through the hum filter for the high tension supply.

If an ordinary a-c chassis is used for the receiver, the r-f filter network may be located in a metal shield box in the position normally occupied by the power transformer.

As regards the amount of r-f filtering to be included in a receiver, it is only possible to be guided by individual circumstances. In some localities, and, perhaps, on ships at sea, there may be very little interference.

On the other hand, the writer has often had occasion to instal receivers in the city of Sydney area where it was a major problem to obtain reasonable reception even of the eight local stations.

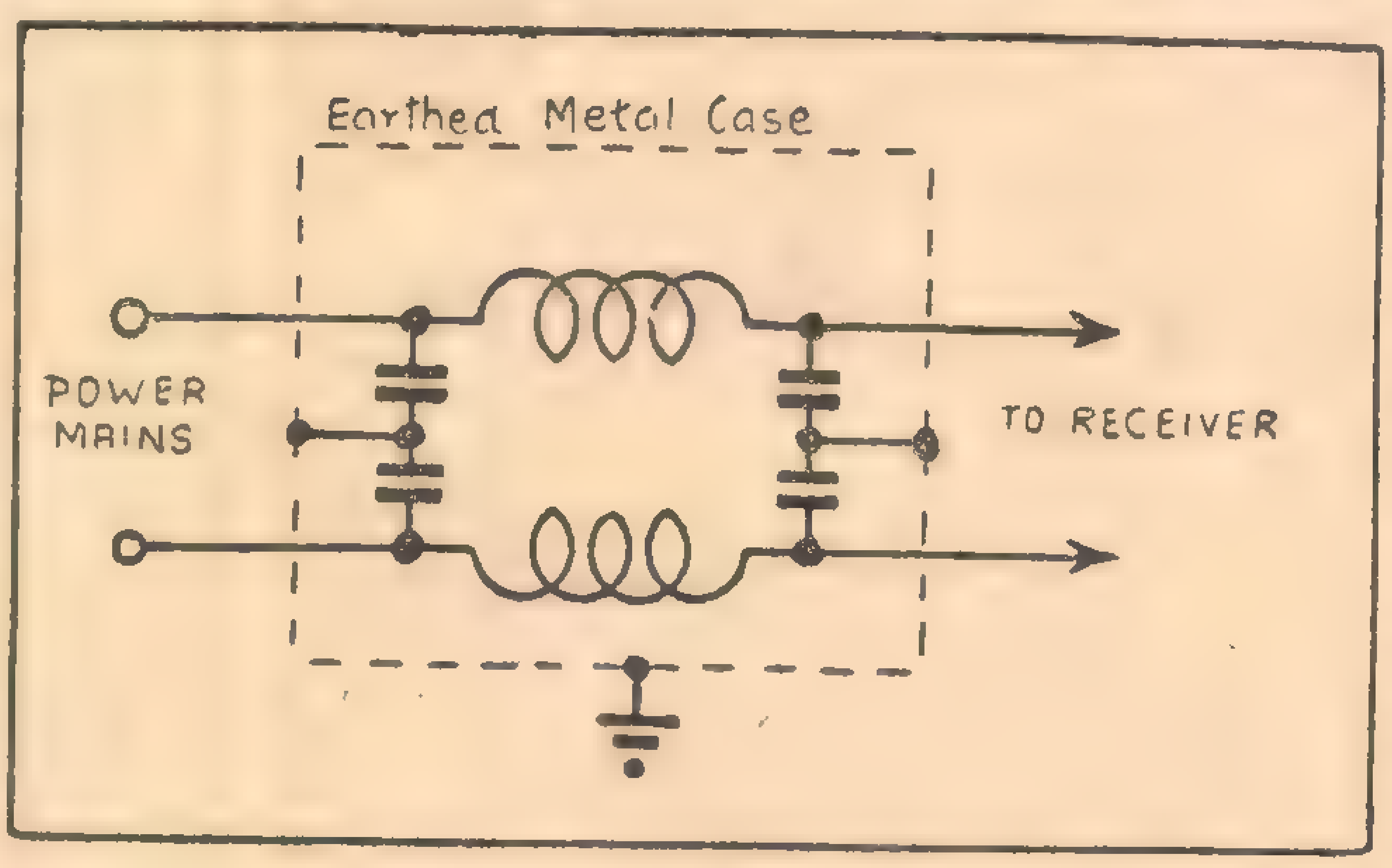

Figure 7. In some d-c areas, the interference level is very high and it is necessary to construct a line filter unit external to the chassis. The unit should be earthed properly and the effectiveness noted with and without the two bypass condensers on the receiver side of the filter chokes.

Once again, the value of a noise reducing aerial system depends entirely on circumstances. The general idea is to remove the aerial proper as far as possible from the field of interference, and to connect it to the receiver by some form of lead-in which does not itself pick up r-f voltages. The whole effectiveness of the scheme depends on whether or not it is possible to remove the aerial proper from the field of the interference.

HEATER SUPPLY

The next problem is the connection of the heaters. In an ordinary a-c mains receiver the heaters of the various valves are simply connected in parallel and supplied from appropriate windings on the power transformer.

For the sake of convenience, it is usual to arrange matters so that all the valves, apart perhaps from the rectifier, have the same heater voltage. The heater current of the individual valves is unimportant, it being necessary only to see that the winding on the power transformer is capable of supplying the total amount of heater current for all the valves.

In the case of a d-c mains receiver there is no power transformer providing, as it does, a convenient method of obtaining a suitable low voltage supply for the heaters, totally isolated from the power mains. As in the case of the high tension supply, it is necessary to have some less satisfactory arrangement, recognising the fact that the heater circuit must be directly connected to the power mains.

PARALLEL CONNECTION?

It is not satisfactory to connect the heaters in parallel in a d-c mains receiver. In a typical case, the heaters may require a supply of 6.3 volts at a total current of, say, 1.6 amps. To supply this from the 240 volt d-c mains would require a series dropping resistor of 148 ohms and capable of dissipating 380 watts.

Adding to this figure the 20 odd watts dissipated in the high tension supply, it follows that the total dissipation would be in the vicinity of 400 watts. This is quite a sizeable amount, considering that the average domestic radiator draws only 1000 watts.

Economy of operation is not the only barrier to such a scheme. The dissipation of that amount of heat in the confined space of a radio cabinet would be a major problem.

More satisfactory operation may be had by connecting the heaters in series, instead of in parallel. This does not eliminate the necessity for the dropping resistor, but does reduce the current flowing through it and the voltage across it.

In a series network the current rating of the individual heaters is of greater importance than the voltage rating. The more or less standard current rating for mains valves in this country is 0.3 amp.; at least, this is the current rating for the majority of 6.3 volt valves, apart from output valves and rectifiers.

If we arrange a series network of heaters it is necessary to see that all the heaters are rated to draw the same current, which may conveniently be 0.3 amp. If we attempt to connect into the network heaters rated at more than

0.3 amp. these heavier heaters will not receive the necessary heating power. Heaters rated at less than 0.3 amp. would be overloaded.

In cases of necessity, the lower rated heaters can be shunted, individually or in groups, with parallel resistors, so that the heaters only pass the correct amount of current. However, this is rather inconvenient, and is usually avoided by suitable choice of valve types.

The chief difficulty in regard to valve types is the output valve, which normally requires a heavier cathode and heater dissipation than other valves in the receiver. In a-c mains receivers this can conveniently be provided by increasing the current rating of the heater of the output valve.

HIGH VOLTAGE HEATER

For reasons which we have just explained, it is not desirable to use a valve in a d-c receiver having an abnormally heavy heater current. For d-c and ac-dc receivers, certain output valves have been produced having a standard heater current, but an increased heater voltage. As far as Australia is concerned, the best known of these is the 43, the 25A6-G and the 25L6-GT, all of which have heaters rated at 25 volts and 0.3 amp.

These valves may be connected in series with other heaters rated at the usual 6.3 volts, 0.3 amp. In a typical receiver involving four 6.3 volt valves and one 25 volt valve, the voltage to be applied across the series heater network would be 50.2 volts.

The series dropping resistor would need to introduce a voltage drop of 189.8 volts at a current of 0.3 amp. The d-c resistance would, therefore, be 630 ohms and the wattage dissipation 57 watts—quite a different figure to the 380 watts mentioned earlier for the parallel connection.

SPECIAL VALVES

Actually, within recent years, two special series of valves have been introduced with a view to the needs of d-c and ac-dc receivers. There is a continental series of valves drawing a standard heater current of 0.2 amp.; another complete American series operates with a heater current of 0.15 amp., with heater voltages ranging from 12.6 to 50 volts.

The use of either of these special valve series further reduces the heat dissipation in the series dropping resistor. However, at the present time these low-current valves may be even more difficult to obtain than the ordinary 0.3 amp series.

In USA the standard line voltage is in the vicinity of 110 volts. By a careful selection of valve types, it is possible to make the heater voltage add up to something like 110 volts, thus eliminating the need for a series dropping resistor, or, at least, reducing its proportions.

A DIFFERENT PROBLEM

This fact, together with the decreased risk of serious shock and the wider use of d-c mains, explains the popularity in the States of small d-c and ac-dc "transformerless" receivers. In Aus-

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tralia, the higher voltage supply mains makes the problem quite a different one.

The voltage dropping resistor may take several forms. The obvious form is that of a conventional heavy duty resistor, wound on some heat-resisting material and mounted on the chassis in a position where the radiated heat will not unduly affect the other components.

The latter requirement is quite important, and many manufacturers adopted the procedure of mounting the dropping resistor in a case quite separate from the receiver chassis.

BARRETTER LAMP

An alternative idea, widely used in America, is to run the resistance wire along the line cord, where it had plenty of opportunity to dissipate the heat generated. The scheme naturally requires special line cords, and does not lend itself to individual receiver construction.

The third method—and the most satisfactory for local conditions—is to use a "barretter" tube. A barretter tube is a device which is designed to limit the current flowing in a circuit to some predetermined figure, introducing a certain order of voltage drop, depending on the tube type.

The barretter tube of particular interest in Australia is the Radiotron 302, which is designed to limit the current flowing to 0.3 amp., and is capable of introducing a voltage drop of from 112 to 195 volts.

ACTION AUTOMATIC

Its limiting action is entirely automatic, and, provided that the required voltage drop is not outside the limits mentioned, a barretter of this type, connected in series with a number of 0.3 amp. valves, will maintain the correct current and ensure the application of the correct voltage to the individual valves.

The operating range of 112 to 195 volts is sufficient for the majority of cases. In the event of a voltage drop greater than 195 volts being required, the barretter may be supplemented by a small additional series dropping resistor designed to bring the voltage drop within the range of the barretter.

Thus, if a voltage drop of 210 volts is required, it would be satisfactory to use a 302 barretter in series with a resistor of 67 ohms or more, introducing a voltage drop of at least 20 volts. The slight margin is desirable to protect the barretter against overload in the event of an upward surge of the line voltage.

THE DIAL LAMPS

The lighting of the dial lamps in a d-c receiver is another problem. When cold, the d-c resistance of valve heaters is very low, and, for the few seconds after switching on, the current through the series network is very much higher than the operating figure, which we are taking to be 0.3 amp.

The result is that any dial lamps in the network light up very brilliantly for the first few seconds, the brilliance diminishing as the current falls to the correct figure.

Even assuming that 0.3 amp. dial lamps could be readily obtained, it is not desirable to connect them directly in the series network. The burning out of a dial lamp would open-circuit the network and render the receiver inoperative.

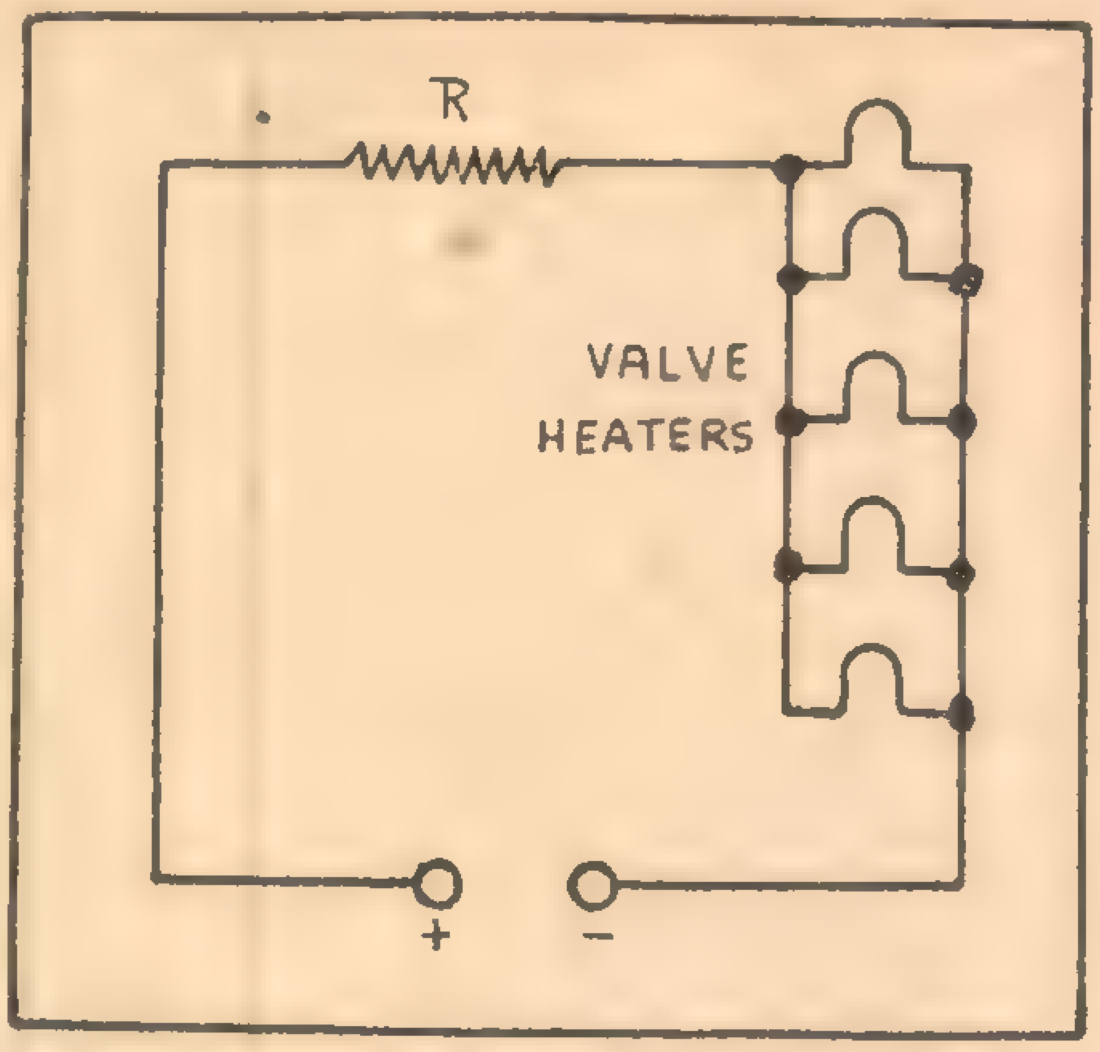

Figure 8. Owing to the amount of power which would be dissipated in the dropping resistor R, it is not a satisfactory proposition to connect the valve heaters in parallel in a d-c receiver. A series connection, as shown below, is very much to be preferred.

If lamps drawing less than 0.3 amp. are used, they may be shunted with parallel resistors, which will carry the load in the event of the lamps burning out. With a barretter in circuit, the change in total circuit resistance will automatically be compensated. With no barretter, the voltage across the individual heaters will inevitably drop, but not necessarily by a sufficient amount to impair the operation of the receiver.

In order to afford some protection to the lamps during the heating-up period, it is usual to arrange the shunting resistor so that they are at less than normal brilliance under operating conditions. This is merely a compromise between the amount of protection afforded and the brilliance of the lighting.

The lower the value of the shunting resistor, the more effectively will the lamps be protected, but the lower will be the dial illumination.

The values of the main series dropping resistor, if used, and of the shunting resistor for the dial lights may be calculated by Ohm's law. In this connection, we can do no more than refer the reader to the current series of mathematical articles.

By using very special circuits, some of the difficulties in regard to the dial lamps may be avoided, but these circuits do not lend themselves readily to local conditions.

Ideally, the dial lamps should be connected into circuit so that they are at the lowest possible potential with respect to the chasis. This minimises risk of shock.

OUTPUT VALVES

Special output valves, such as the 43, 25A6-G and the 25L6-GT, were designed with a view to American conditions and are not ideally suited to the requirements of Australian d-c mains receivers operating from 240-volt mains.

Inspection of the characteristics and ratings of these valves will show that they are designed for operation with plate and screen voltages between 100 and 200 volts, as compared to the usual 250 or 300 volts. This means that the receiver has to be designed with due respect to these ratings. Space will not permit a discussion of the voltages supply problems of individual valve types.

Generally speaking, it is desirable to arrange matters so that the full available voltage is applied to the valves in the tuning end of the receiver. The output valve, requiring lower plate and/or screen voltages, may be supplied through a separate network.

There is an endless variety of individual requirements and possible valve combinations which may or may not warrant different treatment. This resolves itself into a matter of design details which can scarcely be discussed here at any length.

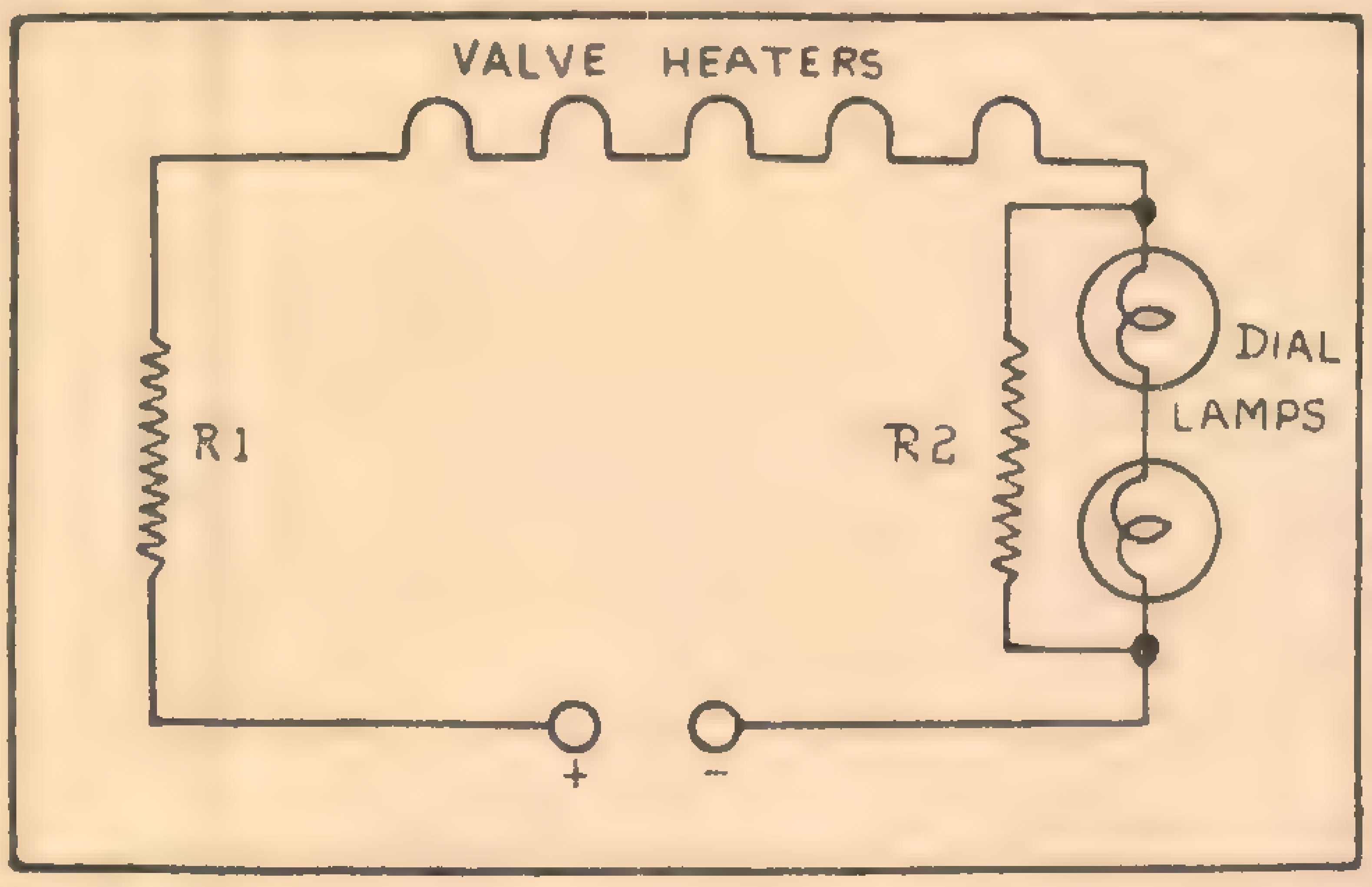

Figure 9. A typical series-heater network, as employed in d-c mains receivers. R1 is the main dropping resistor, which may be an actual resistor or a barretter tube. R2 is in shunt with the dial lamps, protecting them against surges of current and serving to maintain the receiver in operation should either dial lamp burn out. The valve heaters should always be connected at the negative end of the network.

In the few cases where the line voltage is 110 volts d-c, it is necessary to avoid, at all costs, excessive voltage drop in the filter system and to apply the full available voltage to the plates of the various valves. Low voltage operating conditions can usually be obtained for the majority of ordinary valve types.

In the case of such receivers, it is out of the question to use the loudspeaker field as a filter and it must be connected either as a shunt field or else obviated by the use of a permagnetic speaker.

TYPICAL CIRCUIT DIAGRAM FOR A D-C MAINS RECEIVER

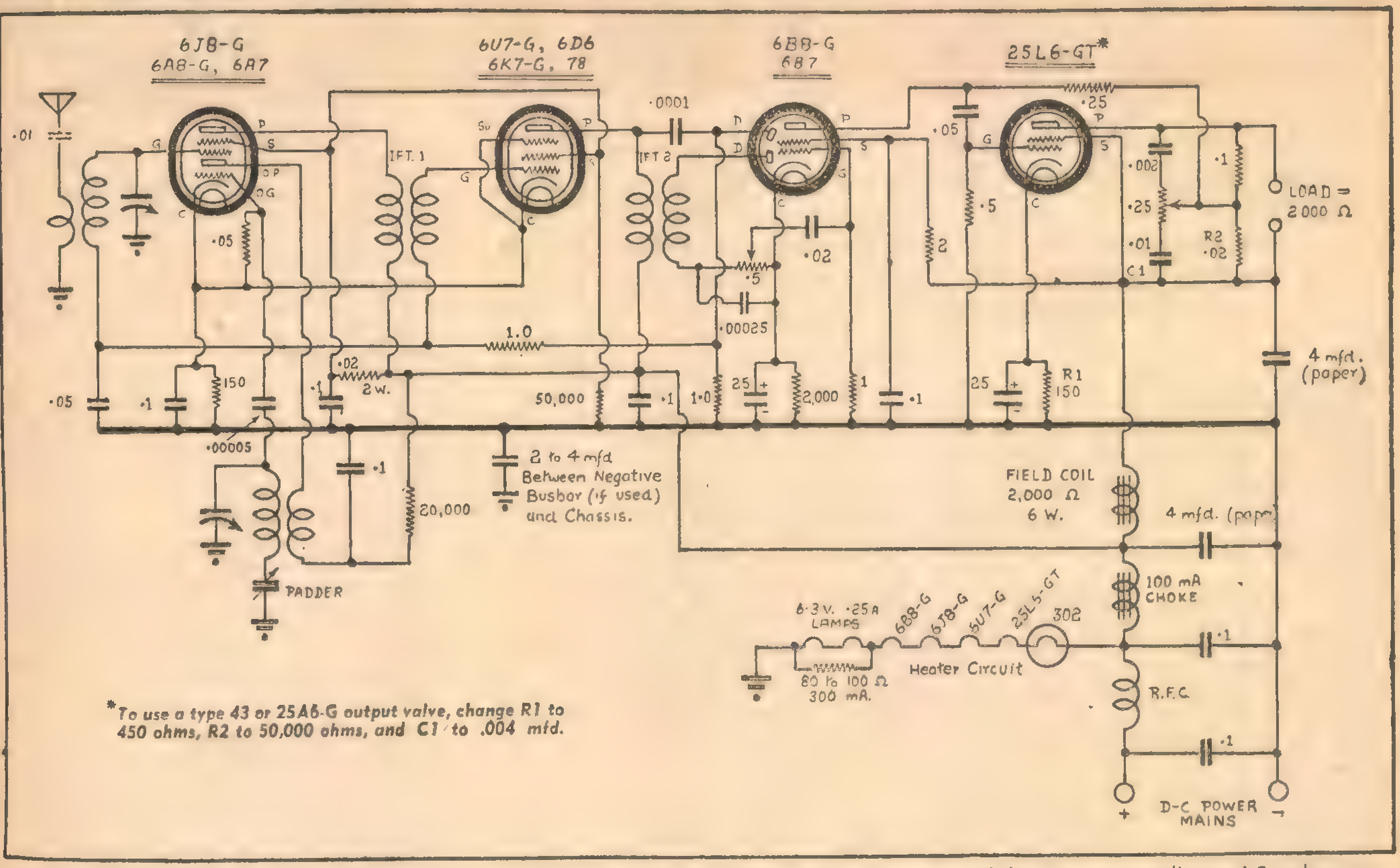

Figure 10. Here is the circuit diagram for a d-c mains receiver. It follows the same general lines as any ordinary 4-5 valve a-c superhet. As explained in the text, there are two methods of construction, using either the chassis or an insulated busbar as the negative return. In the latter case, the busbar will need to be bypassed to the chassis by a large paper condenser.

To illustrate the practical application of the principles explained in this article, we present the schematic circuit diagram of a receiver for operation from d-c mains. The circuit is along conventional and standard lines and does not represent an attempt either at complexity or extreme simplicity.

The most unusual feature of the circuit is the common negative return for the resistors and condensers. This is for the benefit of constructors who may choose the second method of construction described in the article. The points connected to an earth symbol return to the chassis in any case.

H-T FILTERING

The negative power lead connects directly to this busbar. The positive lead is taken through an r-f and low frequency filter to the high tension supply. The amount of low frequency filtering shown is not strictly necessary. However, it is a convenient method of obtaining the necessary voltages for the different valves, at the same time energising a speaker field of standard resistance.

The method of connecting the heaters should be clear enough and should not require further comment If the 302 is not obtainable, it may be replaced by a resistor of suitable design.

In other respects, the circuit is along perfectly standard lines. There are the usual bias resistors and bypass condensers, the usual screen and plate feed arrangements, AVC, volume control and tone control. The various major components are quite ordinary.

The receiver may be built up as a dual-wave receiver by adding the usual coils and switching arrangements. If desired, it would not be a difficult task to add an r-f stage.

As for the valves, the various alternatives are marked. Except in the case of the output valve, the only alterations would be in respect to the socket and wiring.

HOW IT WORKS—THE STEAM ENGINE

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slide, in a small cylinder, to and fro over steam inlet holes at the top and base of the main steam cylinder. The cylindrical valve eliminates friction.

In the lower part of the diagram are shown the necessary parts of a simple railway engine.

The whole working is the same as in the other engine, except that the connecting rod drives the axle of a pair of wheels instead of a crankshaft. Actually there are two cylinders and two connecting rods. The diagram also shows the arrangement of a locomotive crank axle and wheels.

There are a few special points about the design of a railway locomotive. The regulator in the dome is the steam-valve, and is worked by the regulator handle in the driver's cab. Steam from the boiler collects in this dome, away from the boiling water, so that it does not carry too much water with it when it is released. The boiler is fed with water to replace that which has been boiled away by a little device known as an injector.

In the smoke-box there are the main steam pipes, super-heating elements, and spark arresters, and also the blast-pipe through which the exhaust steam from the cylinders passes on the way to the chimney.

Superheating, introduced over 30 years ago, caused a revolution in boiler capacities. In the conversion of heat energy into mechanical energy, the more that steam is heated the more work it will do, and as the pressure increases, the more power and force it attains.

Thus the steam used in locomotives is taken to a higher temperature and pressure than normal—that is, it is "super-heated." This minimised condensation in the cylinders, making it possible to use larger cylinders, in turn increasing hauling power.

The engine sketched is in the very simplest form, and many fittings have been left out. These include the special apparatus for making the vacuum for the brakes, for altering the movement of the valves (for reversing), and for pouring sand under the wheels when the rails are slippery.

WORK OUT YOUR OWN MATHS PROBLEMS

So far, in this series of articles, we have discussed a number of elementary mathematical formulae and have illustrated their application for the solution of typical problems. We now propose to go a step further and show how the same formulas are used to determine the various component values in a typical receiver circuit.

by C. E. Birchmeier

AS a basis of discussion, a typical six-valve receiver circuit has been chosen, as this should provide ample scope for the application of the various formulae. Naturally, the discussion does not by any means exhaust the applications but it should serve as a link between the purely mathematical side and radio receiver design.

Before proceeding, it may be wise to present a brief review of the work covered up to date. In the April, 1942, issue, Ohm's Law in its various forms was fully detailed. This law is probably the most important one in radio work and must be thoroughly understood before passing on to any of the others.

This was followed in the May issue by a complete discussion of formulas to do with power necessary for the determination of the power or wattage developed in a circuit.

The June issue then dealt with series, parallel and series-parallel resistor arrangements; last month's issue followed on from this point and gave certain practical applications of such networks, such as bleeder resistors and voltage divider systems.

REVISION WORK

If you have been studying these articles, there should be no difficulty in following the analysis of the accompanying circuit. Should you be doubtful on any of these points, then we suggest you read over the appropriate issue before going any further.

It should be emphasised that, up to the present, only d-c circuits have been considered, as it would be very unwise to deal with a-c circuits until the former are fully understood.

So much for preliminary remarks; we will now proceed without further ado and discuss the accompanying circuit.

As mentioned previously, a six-valve AC receiver circuit has been chosen; reference to this diagram will show that some of the component values have been omitted. Our job now is to determine suitable values for each of these, so that best results may be obtained from the circuit.

Since it will be necessary frequently to refer to the current and voltage values for the various valves, we are assuming that you have on hand a reliable valve data chart or handbook, from which this information may be obtained.

First of all, we have to determine the high tension voltage required for the receiver. Reference to our valve data shows that all these valves are best operated with about 250 volts on the plate, so we will keep to about this figure.

Now, in applying 250 volts to the 6V6G plate and screen, we find that a grid bias voltage of —12.5 volts is required, so actually we will need a high tension voltage of 262.5 volts if the plate to cathode voltage is to be 250 volts.

The power supply is quite conventional, consisting of a 100 milliamp power transformer with a 385 volt per side secondary winding and a 5Y3G rectifier.

By adding together the rated values of current for all the valves, we find that the no-signal current drain of the set is just over 80 milliamps. We can also allow a couple of extra milliamps for the divider network supplying the screens.

On referring to the 5Y3G operation curves, we find that the voltage output from the rectifier would be approximately 400 volts, with an input of 385 volts and a current drain of, say, 83 milliamps.

However, since only 262 volts are required, it will be necessary to arrange a voltage drop of about 138 volts. This is most conveniently done by connecting the speaker field coil in series with the high tension line. In addition to giving a voltage drop, it also provides an easy means of energising the field magnet of the speaker.

FIELD RESISTANCE

Assuming a voltage drop of 138 volts and a no-signal current of 83 milliamps, the required d-c resistance of the field would work out to be 1660 ohms.

The nearest standard value is 1500 ohms, which would allow slightly more than the calculated value of high tension voltage. The use of a 2000 ohm field would result in a rather low supply voltage, although it would not be far out under typical conditions, where the AVC action reduces the gain of the r-f and i-f amplifying valves.

Alternatively, it would be possible to use a 1500 ohm field and a power choke, which together would just about make up the correct d-c resistance. Moreover, the use of a two-section filter would improve the filtering.

However, let us assume, for the sake of simplicity, that we decide to use the 1500 ohm field and to tolerate the rather high supply voltage.

FIELD ENERGISATION

The next thing is to see that the field coil of the speaker is properly energised. Speaker manufacturers specify the correct energisation for their units, and, while not very critical, the figures recommended should nevertheless be duly observed.

The formula for determining the wattage dissipated in a resistor—or, in this case, a field coil—was given as formula (4) in the May, 1942, issue.

Assuming a current drain of 83 milliamps and a field resistance of 1500 ohms, the wattage dissipation works out at just over 10 watts. This is about the right figure for the usual 10in. or 12in. loudspeaker.

So far so good; now let us proceed with the rest of the calculations, considering the RF or tuning section of the circuit first.

Since we have approximately 250 volts applied to the 6U7G and 6J8G plates

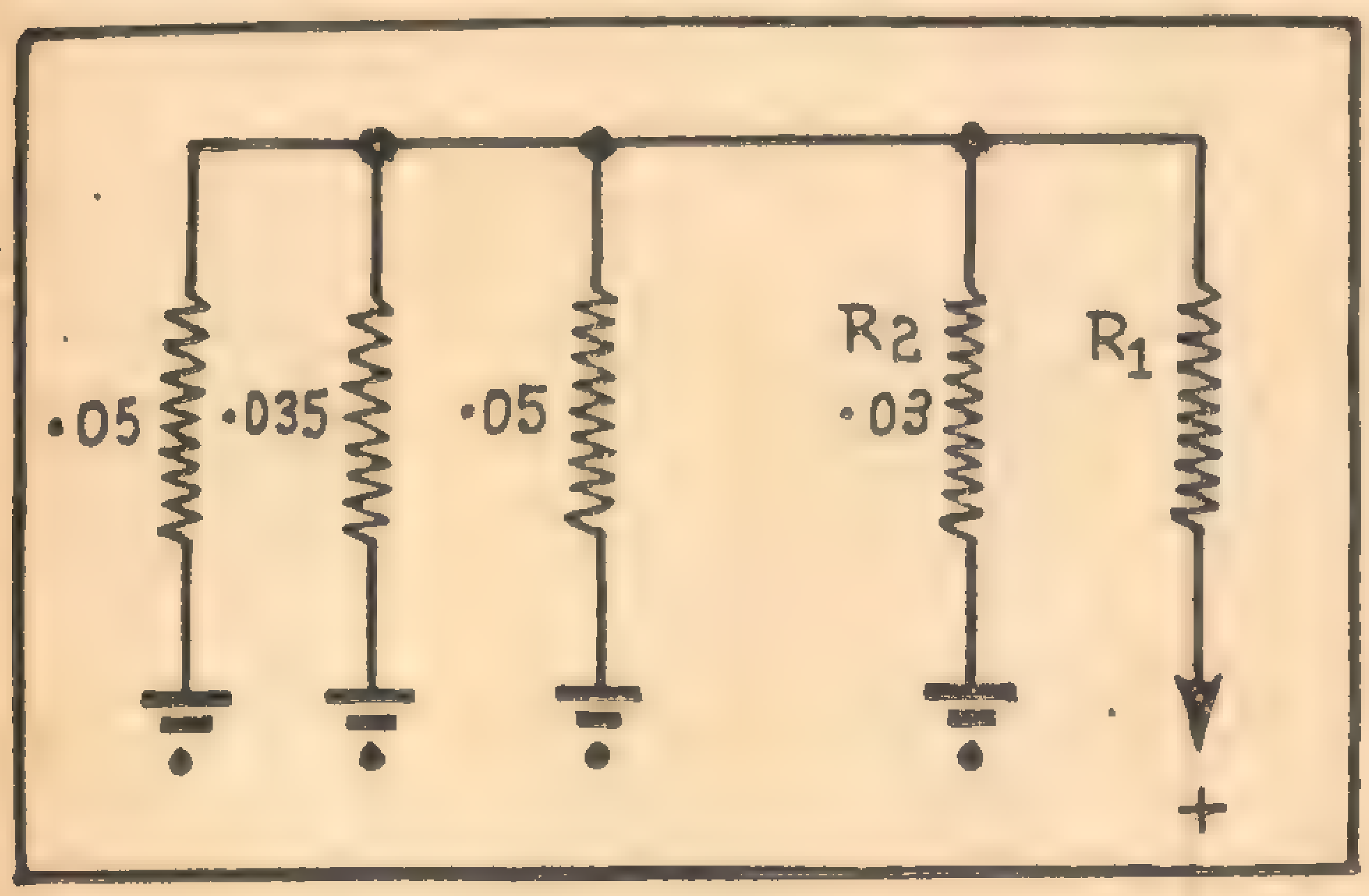


Figure 2. By working out the apparent screen circuit resistance for first three valves in the circuit diagram opposite, this equivalent series-parallel circuit is obtained. Having assumed a suitable value for R2 and knowing the required screen voltage, it is possible to calculate a value for R1.

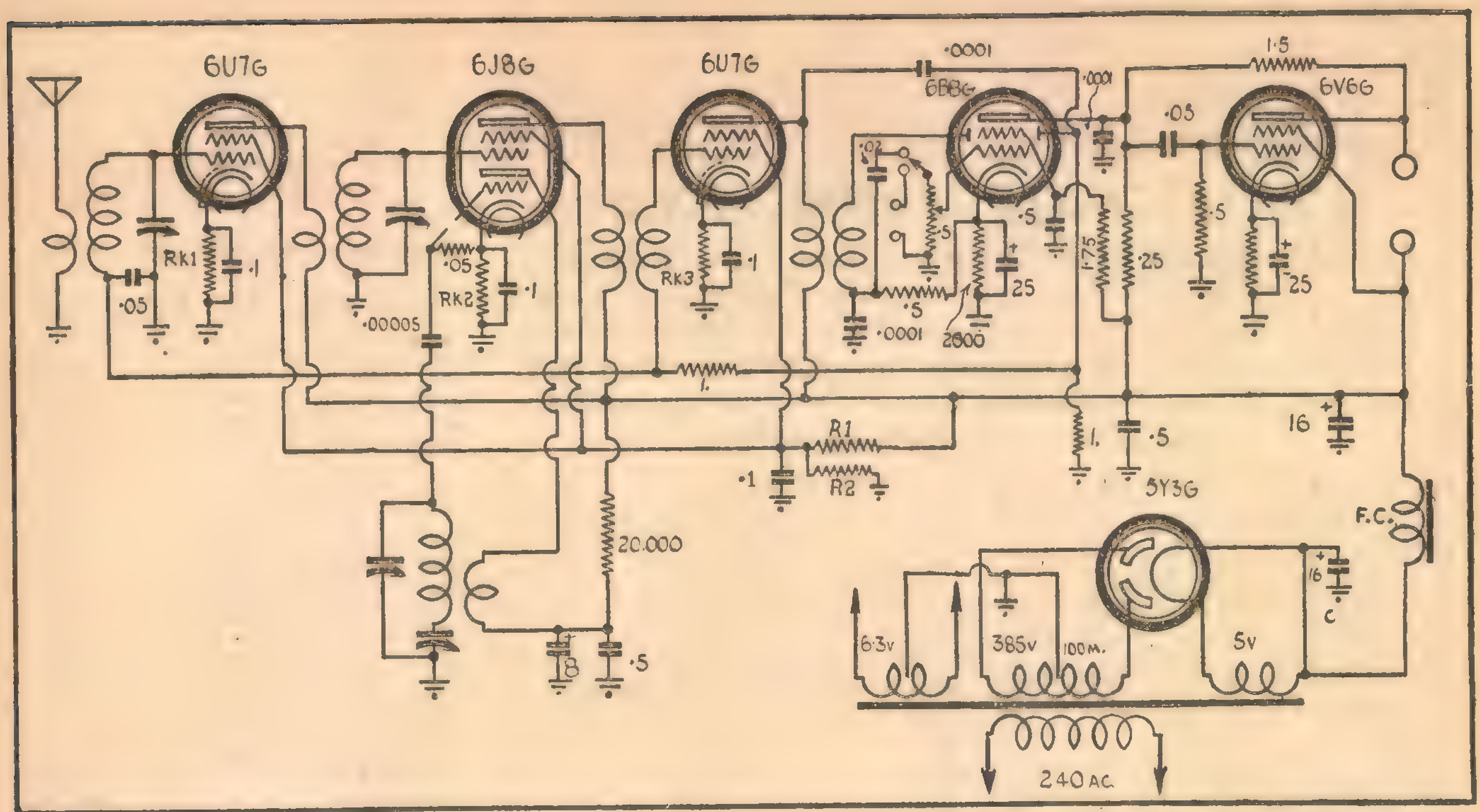


Figure 1. Here is the circuit diagram of a typical six-valve receiver. In the accompanying article the various mathematical formulae previously discussed, are applied to the calculation of the values for different resistors. As explained in the text, not all the resistors are covered since, in many cases, the function of the resistor has no bearing on the mathematical articles to date.

(there will be only a very small voltage drop across each coil, due to its d-c resistance), we find from the valve data that each valve will require a screen voltage of 100 volts. You will notice that the circuit specifies a voltage divider network for the screen supply. This provides reasonably good screen voltage regulation against changes in screen current. Thus, our problem in this case is very similar to that dealt with in last month's issue, except that an extra valve must be considered.

For those who may not be too clear on this subject, we will briefly show you how these two resistor values are determined.

APPARENT RESISTANCE

Since the screen of each valve draws a certain amount of current, it may be regarded as a resistance. The apparent internal screen resistance of each valve will, in effect, be connected in parallel with R2.

This apparent screen resistance is obtained by dividing the screen current into the screen voltage—namely, 100 volts. The 6U7G screen current is 2.0 milliamps, whilst that of the 6J8G is 2.9 milliamps.

If you would care to check up on me, you will find that the apparent resistances for the three valves are 50,000, 35,000, and 50,000 ohms respectively. The equivalent circuit is therefore as shown in figure 2.

If R2 is given a value of 30,000 ohms, the effective net parallel resistance of R2 and that of the screens will be approximately 10,000 ohms. For practice try working this out.

Referring back to the circuit, we know that the voltage at the junction of R1 and R2 must be 100 volts. We have found, further, that the net parallel impedance between this point and earth is 10,000 ohms.

It follows that the total current flowing to earth from the junction of R1 and R2 must be 10 milliamps (100 volts, 10,000 ohms). Furthermore, this 10 milliamps must flow through R1 and the voltage drop across R1 must be near enough to 162 volts.

The value of R1 is found by using the formula R equals E/I x 1000; this works out to be 16,200 ohms. This is an odd size, and, in practice, any standard value between the limits of 15,000 and 20,000 ohms would probably be found to be satisfactory.

CATHODE BIAS RESISTORS

As far as the wattage dissipation in the respective resistors is concerned, you will find that R2 could be an ordinary 1-watt type, but R1 would need to be able to dissipate 1.5 watts. A 2-watt or even 3-watt resistor would be desirable for this position.

Now that the plate and screen voltages for these valves are known, we can determine the value of the cathode bias resistors, Rk1, 2, and 3. The purpose of these resistors is to develop a certain voltage drop, which, appearing between the control grid and cathode of the respective valves, acts as a negative grid bias voltage.

The value of this resistor is quite simply obtained by dividing the total current flowing through it into the required bias voltage.

In the case of the 6U7G's, we find from our valve data that the total cathode current (plate and screen) is 10.2 milliamps, and the required bias voltage is —3 volts. (There is no initial voltage on the AVC line.)

Thus, the resistor required will be 3/10.2 x 1000, or approximately 300 ohms. So this value resistor would be used for Rk1 and Rk3.

BIAS FOR THE 6J8G

Now let us refer to the 6J8G. Here we find the total cathode current is 9.6 milliamps and the required bias voltage —3 volts; from our formula we find the resistor value is again near enough to 300 ohms.

You will note that we have marked in the value of the feed resistor for the 6J8G oscillator anode. We are saved the trouble of working this out, because it is specified in the majority of valve data charts. In any case, it is a simple dropping resistor, required to drop the voltage by so many volts at so many milliamps.

The remaining resistors used in the r-f section of the receiver are used for decoupling and voltage distribution. It is not possible at this stage to discuss why certain values are chosen, but it is sufficient to say that the values are

(Continued on Page 56)

THE MONTH ON SHORT WAVES

by Ted Whiting

S.W. SIGNALS FROM U.S.A.

The most discussed topic concerning Short-Wave listening at the present time is the large variety and number of transmissions emanating from the United States of America. That these transmissions are directed to this country is indeed very fortunate, as they are received by us at strength approaching that of our local broadcast stations.

THE quality of transmission is, to say the least, excellent, and for our part many very interesting hours have been spent in listening to these programmes, wherein are heard all of those people whose efforts we so much enjoy per the medium of recordings.

The various stations referred to are well known to us all, and any doubt may be cleared up by recourse to the Station list, where a full list will be found, but it is very strikingly brought to mind, that we are now hearing signals from the USA from 8 am until approximately 2 am on the next day. It is also to be realised that the best signals are heard at the times when the majority of us are free to listen. This, however, is only one of the countries whose transmissions are to be heard at good strength and good entertainment level.

THE 6MC BAND

Many of our readers have the good fortune to own receivers which will tune to this band, and are finding that reception on these lower frequencies is well worth while, contrary to the opinion of those less enlightened, or whose sets do not take in this band.

Reception in the afternoon is at this time excellent, and we find much pleasure in mingling our memories with the present, while listening to the Home Service of the BBC. This can be heard well from 3.30 pm daily, and some very fine programmes are radiated.

Similar conditions operate in the early morning period at about 5 am, and is well worth getting out of the warmth of the bed to hear. In addition, at this time, we can log several countries in Europe, all at a good readable level.

The general conditions at this time of the year are not the best for this band at night but with careful handling of the receiver, a good showing will result. We understand that those listeners in country districts are enjoying better reception at this time on this band. This is to be expected, and is one of the penalties we pay for residing in the cities.

NEW SERVICE

Many of our readers will have seen the reference in the Press some days ago to the fact that yet a further service is to be commenced from the land of the Stars and Stripes. The General Electric Company are undertaking this service from their stations located in Schenectady, New York.

Please address all short-wave reports to Mr. Ted Whiting, 16 Louden-street, Five Dock, NSW.

The station to be used is WGEO, and it is to open at 8 pm daily. As yet we have no details of the frequency to be used, but it will be worth while watching its frequency, 9530kc. We will be interested to receive any reports on this station regarding its coverage all over the country.

Those High Frequency Bands

MANY readers will have noticed that we reported in past issues that the stations which we are accustomed to hear on the higher frequency bands have departed with the summer season so to speak.

We are afraid that we were not altogether correct, as by one of those unexpected turns we find that Dame Nature has forestalled us and that, at the present, it is possible to hear at least some of the stations, which are operating on the 16m band.

We are able to hear the Daventry and the Berlin transmitters on almost every night from about 10 pm at quite good volume. This is in itself a very consoling thought as, these days, we find that the 19m band has taken a turn for the worse. At this time, it is not the best vehicle for the transmission of the ether waves.

This is not the case in the matter of the 13m band, which has been an utter failure for the last 12 months, and for which we have already given up any hope. Some years ago, we were accustomed to hearing very good signals on this band, and we hope that in the next summer season we will once again hear those signals on this band.

News in English

MANY have been the queries we have received as to when it is possible to hear the news under the best possible conditions. In these days of international turmoil, we are all to some extent interested in the dissemination of news by those of our Allies whom it is possible to hear.

It is, at the present time of the year, with the average receiver, easily possible to hear the news from many countries who are friendly to us; at the same time, it is also an easy matter to hear what are purported to be broadcasts of the latest news from transmitters owned and operated by countries sympathetic to the Axis cause. These broadcasts are, from the point of view of entertainment, rather good and we have heard from them many items of news which have given us much amusement.

FROM THE B.B.C.

The broadcasts from the BBC are always to be relied on and can be heard at various times through the day. The BBC are also giving a very fine service through the stations in the Home Service. These transmissions are best heard in the early morning and also at around 5 pm in the evening. The best time in the morning is also at 5 am. These stations are heard at very good strength at these times.

From America, we are able to hear news casts at intervals of approximately an hour throughout the day, especially as at the present time we are able to hear a good signal from the States at any time of the day. These casts are given in the typical American manner, and are followed by talks given by eminent commentators and are of a very high standard.

RUSSIAN BULLETIN

Frequent news bulletins are heard from Russia, and always give the latest news of the struggle taking place in that part of the world. These transmissions are heard in English, and are heard at good strength both in the daylight hours and also at night.

At the present time, we very rarely hear news from Sweden. Many people will be interested to learn that this country is easily heard giving a transmission of news for the benefit of the USA at both 1 am and 1 pm. We have been hearing this transmission for some months here in the suburbs of Sydney, and we know that those people who are fortunate to live in far better locations than ours are getting phenomenal reception at the present time from the Motala transmitters.

We would suggest that those who are interested in these news bulletins turn to the station list for further information.

WHEN AND WHERE TO LISTEN

Here is a chart for quick reference, giving the call and listening times for the best short-wave stations on the air. Where the station is not receivable at good strength when it comes on the air, the time is given at which reception should be satisfactory.

6 a.m. TILL NOON

GRW, 48.86m, London. Heard well at 6 am until 6.30 am.

Bucharest, 32.41m, Rumania. Now heard at good strength at 7 am.

DZD, 28.45m, Berlin. This one audible at 7.15 am, on opening.

WGEA, 19.57m, New York. A good signal at 8 am.

GRY, 31.25m, London. Still good at 8 am.

GRF, 24.80m, London. This one heard well at 11 am.

SBP, 25.63m, Stockholm. A good one in news at 11 am.

GRV, 24.92m, London. Still good at 11 am.

Best reception period from 8 am till noon.

NOON TILL 6 p.m.

KGEI, 19.57m, San Francisco. Heard well at 1 pm.

KWID, 19.62m, San Francisco. This one is good at 1.30 pm.

GRG, 25.68m, London. Audible at good strength at 12.45 pm.

OIX3, 25.46m, Helsinki. Good at 1.5 pm in news in English.

KRCA, 31.65m, San Francisco. Good signal on opening at 3.30 pm.

TPZ2, 25.76m, Algiers. Heard well at 4.45 pm, on opening.

2RO3, 31.15m, Rome. Fine signal at 5.20 pm, with news in English.

Best reception period from 1 pm till 5 pm.

Please send reports for next issue to reach us not later than Saturday, August 1, 1942.

6 p.m. TILL MIDNIGHT

KRCA, 28.85m. This one in operation at 7 pm.

WJQ, 29.97m, New York. Fine signal at 8 pm, on opening.

CBFY, 25.54m, Montreal. Comes in well at 9.30 pm.

Radio Saigon, 25.47m. Still reliable at 9 pm.

VUD2, 31.28m, Delhi. Good signal at 10.30 pm.

XGOY, 31.17m, Chungking. News is heard well at 11.30 pm.

Russia, 23.06m, Kuibyshev. Also heard with news at 11.30 pm.

WNBI, 16.87m, New York. A fair signal at 11.30 pm.

Best reception period from 9 pm till 11 pm.

NEW STATIONS OF THE MONTH

GRF, London—Nairobi, Africa—Delhi, India

LONDON

THE first station to be reported in the above category is very appropriately located at the centre of the Empire and is being heard at tremendous strength daily at this location; from all reports we have received this month it is being heard everywhere in the same excellent fashion.

The new station is GRF, and is operating on 12095kc, 24.80m. The time of operation is during the forenoon in the BBC service to South America, which, as you know, is conducted in Spanish. This transmission is taken in company with GRV, which is also heard at very fine strength at the same time.

VQ7LO, NAIROBI

WE hope that readers will soon be hearing yet another African station, which is at present being heard in Western Australia. The new station is the new outlet of VQ7LO, and is radiating the same programme as the transmitter on 49.5m. This new one is to be heard on 29m or 10.345kc, and we have every hope of hearing it very soon. We are aware that several of our readers are very interested in the Nairobi station, and we hope that they are also successful in logging the new addition to the service. The information was sent to us by Mr. Walker, of Applecross, WA.

DELHI, INDIA

THE Indian broadcasting authorities have recently commenced operation on some new frequencies. The stations are, we presume, located in various parts of the country, as their call signs denote, but they all seem to be linked up to take the broadcasts we are hearing. The first is VUD2 11.830kc, 25.36m. Then we have VUB2, 7240kc, 41.44m; VUC2, 7210kc, 41.67m. These stations are being heard here at very good strength, and can be heard at 10.30 o'clock nightly.

Yet a further Indian to come to light is VUM2, which we suspect is located in Madras. This one operates on 7270kc. 41.27m, and is not heard at the same time as the others. This one is being heard at 1.30 am, and our correspondent, Mr. Gillett, of SA, is hearing this one at what he terms terrific strength. We heard this one ourselves today, and we have no doubt of its strength when intercepted in the country.

SINCE writing the body of the notes for this issue we have heard that the American station WGEO is transmitting its new service on its old frequency of 9530kc, as we had already forecast. The signal, as we have heard it, has up to the present been rather disappointing, as it is not to be compared with the signal put out by WJQ at the same time. However, we have hopes of better results from this station before long, and we have no doubt that some very interesting programmes will be heard from Schenectady in the very near future.

KWID, SAN FRANCISCO

FURTHER reports are to hand regarding this now popular station, which is being heard so well at the present time. We are pleased to say that the operating time of the station has been extended to 7 pm, which, at the present time, is very little use to us here. However, we are sure that before long we will be able to make good use of this extra period, and we hope to hear some very interesting items on this frequency. It is also reported that they are using the RCA transmitters used also by KGEI. These are the transmitters on 6860kc and 9480kc, and a very useful signal results.

REPORTS FROM OUR READERS

THE following readers have sent in reports and letters, for which we are very grateful:—

E. J. Perritt, Marrickville, NSW; M. Morris, Newcastle, NSW; G. Wilson, Albert Park, Vic.; R. Simpson, RAAF; A. R. Smith, Cessnock, NSW; J. Baker, Ryde, NSW; S. Millowick, Mt. Gambier, SA; G. Cooke, Epping, NSW; R. Campbell, Kelvin Grove, Q.; R. K. Clack, Home Forces; J. A. Leech, Guildford, NSW; R. N. Tuxworth, Sarina, Q.; H. Perkins, Malanda, Q.; S. Jones, Punchbowl, NSW; R. M. Churchers, Devonport, Tas.; D. McKinnon, Strathfield, NSW; L. Walker, Applecross, WA; A. Lee, Merewether, NSW; N. A. Hanson, Merrylands; A. E. Moore, New Farm, Q.; A. Cushen, Invercargill, NZ; R. G. Gillett, Dudley Park, SA; V. Rochfort, Grenfell, NSW; L. J. Keast, Carlingford, NSW; J. B. Keenan, Randwick, NSW; A. Condon, Laura, SA; R. Smart, South Caulfield, Vic.; Dr. K. B. Gaden, Quilpie, Q.

WITH OUR S.W. REPORTERS

MR. A. S. CONDON

THIS month we again turn to South Australia to discuss the most consistent listener we receive reports from in that State.

Mr. Condon has been interested in short-wave listening for the past year and a half, and, like many of us on the purchase of a new receiver, has found a new hobby which appeared non-existent.

The location from which Mr. Condon operates is some 140 miles from the City of Churches, Adelaide, and he has the misfortune of being in a part of the town which is prone to interference. However, he is not worried on this account, as is evident by the logs which he turns in each month.

THE RECEIVER

A very popular make of receiver is in use at this location, with a range from 12 metres to 55 metres, and employs some eight valves. This set is constructed for operation on both AC and DC. The line-up of the valves is a very usual one, using the usual RF stage and ending in a push-pull output circuit, the whole delivering the signal with the customary vigor associated with such amplifiers.

The aerial system is a very good one, more especially as the location is one prone to man-made interference. The top wire of the inverted L-aerial is 50 feet long and is slung some 38 feet from the ground, facing in a north and south direction. The set-up employs a transformer in order to transfer the signal to the receiver at the expense of the noise and other interference picked up by the aerial.

VERIFICATIONS

Although the collecting of verifications has only been undertaken for the past few months, cards are held from WGEO, KGEI, WBOS, WRUL, WRCA, WCBX, WLWO, VPD2, COK, VUD3, and CR7BE. In addition to these, there are no fewer than 36 reports out, representing 21 different countries, so by the time our friend receives the cards of this lot he will have an array of which to be proud.

Mr. Condon favors the stations located in the Americas, but apparently not to the extent of the exclusion of the others. This is evident by the fact that 60 countries have been logged, and we have no doubt that this total will be increased in the near future.

Logs are sent out each month to both this magazine and to our contemporary, and we would like to say that these logs are the best we receive, if not from the point of stations heard, then from the angle of composition. They show that the listener has the interest of the hobby at heart, as the arrangement is perfect from our point of view.

Mr. Condon is a member of the "All-Wave All-World DX Club," and has been a reader of Radio and Hobbies for the whole of the time he has been interested in the short-wave hobby. He is only yet another of our reporters who has found the "Who's Who in Short-Wave Broadcasting" section invaluable on many occasions as a reference for the information necessary to obtain a verification.

There is, we feel a very striking moral to be seen in the thoroughness of this reporter in that this quality never fails to bring success.

THIS MONTH'S VERIFICATIONS

CHINA.—Among many other veri's received this month, our friend Mr. Clack was fortunate to receive a veri from XPSA, located in Kweiyang. The form of the card consists of a sheet of heavy paper 4in. x 2½in., on one side of which the call letters are reproduced, while the other side carries the station and verification details in both Chinese and English. The station informs our reporter that, at midnight, they relay the news in English from XGOA, and that listeners may expect them to hear the station using English to a greater extent.

AMERICA.—We are in receipt of the information that our old friend Mr. Simpson has received yet another card for a first verification from Australia. The station concerned this time is WCRC, 6170kc. This makes his total of firsts a very formidable one. He is not the only one to receive a card from this station, as several of our reporters have received cards from this source.

INDIA.—The usual card and programme schedule are still being sent out from the Indian stations in reply to correct reports on their transmissions. These folders are very handy indeed, and are revised fairly regularly. The latest recipient is Mr. Perkins, of Malanda.

BRAZZAVILLE.—In a further verification received by Mr. Clark from FZI we are informed that in the near future this station will be in operation using a more powerful transmitter. Just what their signal will sound like when they increase power we cannot imagine as, in the present circumstances, they pack a punch here. We can no doubt expect an extension of their schedule.

FLASHES FROM EVERYWHERE

AUSTRALIA

A NEW service has been commenced for the benefit of the forces in the field in the Pacific area. This service is transmitted by VLG6 on 19.69m, and is heard closing at fine strength at 8 pm. We have no doubt that the new programmes will be very welcome, and will add to those fine signals which are heard from all over the world at the present time.

HONGKONG

WE are informed by Mr. Keast, of our contemporary, that there is a new station operating on 31.68m from the above territory. The call letters are JQHA and the station is a relay of the broadacst station on 265m. The station is heard to close at 12.08 am. The closing announcements are in English as are the inter-item announcements.

HOLLAND

THERE is a new station operating on the 19m band these nights. This is some of the information sent to us by Mr. Smart, of Victoria. The station is heard on 19.7m soon after the close down of PCJ2. This is a Free Dutch station.

WJQ, NEW YORK

WE know by the number of letters we receive how many people are interested in the transmissions emanating from this station, and, therefore, when we received the following schedule from one of our reporters, we decided that there are many who would welcome its publication.

8 pm, Station opens and commences the 1st News cast. 8.15 pm: Interlude, Charioteers or Concert music. 8.30 pm: News From Home for the forces overseas. 9.0 pm: 2nd News cast. 9.15 pm: Interlude, Dance music or Hill Billy session. 10.0 pm: 3rd News cast. 10.15 pm: Jazz in America, swing music series. 10.30 pm: 2nd Broadcast of News From Home. 11.0 pm: Musical feature or talk. 11.15 pm: More music. 11.30 pm: Dance music. 12 midnight: Final News cast; close down.

STATIONS ABOVE 50 METRES

AS we promised, we are giving some detail of stations on the bands above 50 metres. There are many who have receivers which will tune to these bands, and we hope that these few stations will interest them. We will be in a better position to discuss them more fully in the next issue. Just now we are hearing the following:—

MTCY, 5.7 mc.—Heard well at 12.30 am.

Russia, 5.35 mc.—Closes nightly at 1 am.

YDA, 3.04 mc.—Also on at 1 am.

Bombay, 4.88 mc.—This one is audible at 2 am.

Delhi, 4.96 mc.—Another one on at the same time.

Russia, 4.53 mc.—Heard at 2 am at fair to good strength.

We are very grateful for the assistance of Mr. Keenan in the listing of these stations, and it is our hope that any readers who are interested will drop us a line in time for the next issue. In the meantime, we hope to find the time to log a good few of these stations.

OVERSEAS S.W. STATIONS NOW AUDIBLE

The list of stations shown below comprises only those which have actually been heard in this country during the past few weeks, and does not include stations which are on the air but not heard as yet in this country. A large majority should be heard on any sensitive receiver, and when a station is reported for the first time readers' names who report it are shown in brackets. At the end of each group is a list of correspondents who have sent in reports.

ENGLAND

GSA—6050kc, 49.49m, Daventry. Can be heard daily in the European service at 6.45 am and also at 4.30 p.m.

GSB—9510kc, 31.55. From 5 am in the African service, and from 3 pm in the Pacific service. Good signal at both times.

GSC—9580kc, 31.32m. Heard with fine signal in the N. American service at 8 am to 2.45 pm.

GSD—11,750kc, 25.53m. This one is still one of the best of the BBC transmitters. Heard well in the African, N. American, Pacific, and Eastern services.

GSE—11,860kc, 25.29m. This one is only heard irregularly at 5 pm with a weak signal.

GSF—15,140kc, 19.82m. Heard well in the African, Pacific and Eastern transmission. Best signal is at present in the Pacific service at from 3 pm.

GSG—17,790kc, 16.86m. Can be heard in the Pacific service at 5 pm, and in the transmission in French at 8.45 pm daily.

GSH—21,470kc, 13.97m. This one is not audible at this time of the year. Will be heard in the summer.

GSI—15,260kc, 19.66m. Another Pacific service station heard at 5 pm. Fair signal at this location.

GSJ—21,530kc, 13.93m. The same remarks apply as for GSH.

GSL—6110kc, 49.10m. This station puts in a very good signal in the afternoon at from 3 pm. This is, of course, in the Pacific service.

GSN—11,820kc, 25.38m. This one gives good signal in the forenoon in the transmission for Latin America. Also used in the European service at 6.30 am and 11.30 pm. Good signal at both times.

GSO—15.180kc, 19.76m. Used in the Foreign service. Heard best at 10.15 pm with fair signal.

GSP—15,310kc, 19.60m. At this location is not so good in the Pacific service, but from reports is heard better in other States, particularly S. Australia.

GST—21,550kc, 13.92m. Yet another one put away for the summer.

GSV—17,810kc, 16.84m. Can still be heard in the Eastern service at from about 9 pm. The signal is quite good on a good night.

GSW—7230kc, 41.49m. Another station heard in the European transmission at 5 pm; the signal is invariably good.

GRD—15,450kc, 19.42m. Heard weakly in the Pacific service at 6 pm. Also used in the African transmission at 2 am.

GRE—15,375kc, 19.51m. This one is heard well at 8.45 pm, Eastern service.

GRF—12,095kc, 24.80m. One of the loudest of the BBC signals. Heard in the forenoon at from 1 am in service for Latin America.

GRG—11,680kc, 25.68m. A good signal in the African service at 5.30 am, and is also heard at 6.45 am in the N. American service.

GRH—9825kc, 30.53m. One of the best signals heard in the N. American service. Heard from 1 am until 12.30 pm.

GRI—9415kc, 31.86m. Heard well but irregularly at 9.30 pm.

GRJ—7320kc, 41.00m. Yet another station in the European service heard at both 6 am and 6 pm.

GRK—7185kc, 41.75m. This one is heard in the Home service of the BBC at 3 am and 6 pm. Good signal in both cases.

GRM—7250kc, 41.38m. "Radio Polski." Used in the Foreign service for the benefit of listeners in Poland, and for Polish listeners elsewhere. Heard at 2 am.

GRN—6194kc, 48.43m. Has not been reported this month, and has not been heard here. Used to operate at 5 am.

GRO—6180kc, 40.54m. A good signal in the African service at 3 am.

GRP—17,890kc, 16.77m. This one has not been heard at this location for some time, but is reported as being heard at 10.30 pm in parallel with GSV. This by Mr. Gillett, of SA.

GRQ—18,030kc, 16.64m. Cannot expect to hear this one until the summer season.

GRR—6075kc, 49.38m. A Home service station heard at 2 am and at 4 pm. News is read at both these times. The signal is a good one.

GRS—7065kc, 42.49m. This old favorite station of ours is still heard at its fine strength in the Pacific service.

GRU—9450kc, 31.75m. Heard well in the African service until 2 am.

GRV—12,040kc, 24.92m. Very fine signal in the Spanish broadcast from 8.30 am until 12.45 pm. Also heard at 6.15 pm with fair signal.

GRW—6145kc, 48.82m. The news is heard at 2 am and 4 pm in the Home service from this one.

GRX—9690kc, 30.96m. This is yet another one used in the European service and is heard at 5 pm. Good signal at this time. This one is also heard carrying the news at 6 am in the same service.

GRY—9600kc, 31.25m. Good signal at 5 am in the African service, and at from 6.45 am to 8.40 am in the N. American transmission.

The following readers have reported stations in the above group: Messrs. Churchers, Clack, Leech, Gillett, Morris, Moore, Hanson, Lee, Walker, Condon, Smart, Gaden.

INDIA AND ASIA

JBC—18,007kc, 16.60m, Batavia, DEI. This station is now being heard at noon until 1.30 pm at good strength. It is also heard at 7.30 am and 8 pm.

Voice of Batavia—8846kc, 31.92m. Heard closing with the "Liberty Bell" at 2.30 am daily.

VUD2—6130kc, 48.94m, Delhi, India. A very good signal at from 11 pm to 2 am.

VUD2—7290kc, 41.15m, same location. This one is now heard every night at fine strength at 10.30 pm.

VUD2—11,830kc, 25.36m, same location. This Indian is also heard nightly from opening at 10.30.

VUD3—15,290kc, 19.62m, same location. A very good signal at 12.30 pm, when the news is read. This one is also at good strength at 3 pm.

VUD4—9590kc, 31.28m, same location. Heard with excellent signal at 9 pm.

VUM2—7270kc, 42.27m, Madras. Another new Indian opening at 1.30 a.m. News is heard at 1.50 am at fair strength.

VUB2—7240kc, 41.44m, Bombay. This is also a new one for this part of the country. A good signal is heard when the news is read at 10.30 pm.

VUC2—7210kc, 41.67m, Calcutta. Also heard in the news at 10.30 pm, also with good signal.

VWY—9045kc, 33.17m, Kirkee. Still heard in the transmission to Syria. This is heard at good volume at 3.30 pm.

The Voice of Free India—11,500kc, 26.09m. This one is not reported this month, but is being heard in New Zealand.

XGOY—11,925kc, 25.14m, Chungking, China. A good one in the evening from 6.30 pm. This one closes at 11 pm.

XGOY—5950kc, 50.42m, same location. The evening signal heard at 10.30 pm is not so well heard as is the signal at 6 am.

XGOY—9625kc, 31.17m, same location. News is heard at midnight at very good strength.

XGOY—9635kc, 31.13m, same location. Has neither been reported nor heard this month. Is frequently heard in tests with the USA.

XGOA—9820kc, 30.86m, same location. Is heard as a very good signal from 9.30 pm to midnight.

XGOI—9300kc, 32.26m, Shanghai. This one is also heard at 9.30 pm with a fair signal.

XGOI—9665kc, 31.04m, same location. A very fine signal heard every night, giving the news in English at 10.15 pm.

XGOK—11,650kc, 25.75m, Canton. Only heard on irregular schedule these days. However, is quite good when heard.

XGOX—15,200kc, 19.74m, Chungking. Another good signal heard carrying the news at 7.30 pm daily.

XGRS—11,640kc, 25.77m, Shanghai. English is spoken from this German-owned station. Can be heard on most nights at 7 pm.

XPSA—8465kc, 35.44m, Kweiyang. Heard in native programme at both 6.30 am and 9.30 pm. Good strength at both times.

XGAP—10.270kc, 29.20m, Peking. This one is heard well nightly on opening at 11 pm.

XGAP—6100kc, 49.18m, same location. A good signal from 10.30 pm.

XLMA—9350kc, 32.09m. Heard at 10.30 pm with fair signal.

WHO'S WHO IN SHORT-WAVE BROADCASTING

Radio Tananarive, Madagascar

Frequency: 6063kc, wavelength 49.48m.

Operating Schedule: 12.30 am to 2.30 am (irregularly to 3.30 am).

Standard Time: 7 hours behind EST.

Distance from Sydney: 7600 miles.

Postal Address: Radio Tananarive, Madagascar.

Identification: "Ici Radio Tananarive," between every item. French is always used. Female and male announcers.

Verification Details: In better times sent out rather nice card, but it is doubtful if they will verify these days.

LSX Buenos Aires, Argentina

Frequency: 10,357kc, wavelength 28.98m.

Operating Schedule: 8.30 am to 9 am.

Standard Time: 14 hours behind EST.

Distance From Sydney: 7200 miles.

Postal Address: LSX, Buenos Aires, Argentina.

Identification: Announces in both Spanish and English. Male announcer. The programmes are of the typical Spanish type.

Verification Details: This one will verify with an attractive card, and frequently sends out interesting booklets on the Argentine Republic.

SBP Motala, Sweden

Frequency: 11,705kc, wavelength 25.63m.

Operating Schedule: 3 am to 4 am, and 4.40 pm to 5.30 pm.

Standard Time: 9 hours behind EST.

Distance From Sydney: 9900 miles.

Postal Address: Send your letters to The Swedish American News Exchange, New York, America.

Identification: Male announcers, using English at times when news is broadcast to the USA.

Verification Details: This station, of the Swedish Broadcasting Co., replies to all correct reports by sending out a card. Much literature has also been sent out in the past, but we doubt whether these conditions will operate at the present time.

FREQUENCY STANDARD BROADCASTS

MANY of our listeners may be interested to learn that the National Bureau of Standards in America announces that they are extending their Standard Frequency transmissions which they have made for a number of years. These transmissions are made by Station WWV, and they are now giving a check on 15mc. The broadcast is continuous and is interrupted every five minutes for one minute in order to give the station call. This is made in Morse code. The accuracy is stated to be better than one part in ten million, which is far greater than anything we would ever need. The signal has an audio frequency of 440 cycles. This signal has been heard in the past at this location on the other frequency used, 5mc, this one being used concurrently.

XMHA—11,855kc, 25.30m, Shanghai. Interfered with by DJB, but is sometimes heard at good strength.

XIRS—11,890kc, 25.04m, same location. Another Axis station. Italian owned. At 10 pm is a fair signal.

XGEI—16.092kc, 18.65m, Kuoming. Has been heard testing irregularly for the past few weeks. Is using frequencies in the principal short-wave bands in addition to this one.

FFZ—12,060kc, 24.88m, Shanghai. This one is still struggling behind a blanket of CW interference.

MTCY—11,775kc, 25.48m, Hsinking, Manchukuo. Is heard at 8 pm with a good signal on good nights.

MTCY—9545kc, 31.43m, same location. Is still heard at 7 am with a satisfactory signal.

MTCY—5740kc, 52.28m, same location. Can now be heard at midnight but is only fair.

Radio Saigon—11,780kc, 25.47m, Saigon, French Indo-China. Heard at its usual strength from 8.15 pm.

Radio Saigon—6188kc, 48.48m, same location. Heard from 10 pm, when they are on the air, until 2 am. This one is a great success in the Western State.

CR8AA—6250kc, 48.00m, Macao, Portuguese China. Can be heard at 11 pm on most nights.

HSP5—11,715kc, 25.61m, Bangkok Thailand. News heard at good strength nightly. The remarks are not so clever.

KZRH—11,600kc, 25.86m, Manila, PI. Under Jap control these days. Can be heard on some nights at 6.30 pm. However, 10.30 pm is the best bet.

KZRH—9640kc, 31.12m, same location. Heard on opening at 10.30 pm with a fair signal. The strength of this one is not by any means what it used to be in better days.

EQB—6155kc, 47.74m, Teheran, Iran. A very fine signal heard at 4.45 am daily.

XYZ—6007kc, 49.94m, Rangoon. This one is also under Jap supervision for an indefinite period, and is heard at 10 pm to 11 pm daily. Just a signal at this location.

ZHJ—6095kc, 49.21m, Penang. Similar remarks apply to this one also, only it has not been reported this month.

JTHK—9525kc, 31.50m, Hongkong. Another one under Jap control. Heard at 8 pm on opening. News is heard at 11.10 pm. Good signal.

JZJ—11,800kc, 25.42m, Tokio, Japan. This one with good signal at 7 pm on opening.

JVW—7257kc, 41.34m, same location. Has been heard at 6 am but is now only fair.

JLU4—17,795kc, 16.86m, same location. Heard well at 5.45 pm, giving news.

JZK—15,160kc, 19.79m, same location. A good signal at 4 pm, when the news is read.

JLG—15,105kc, 19.86m, same location. This one has been reported as test with Rome.

JZI—9530kc, 31.46m, same location. Another one from the land of the chrysanthemum. This one reads the news at 7 pm and 10 pm. The signal is a very good one.

XNR2—12,115kc, 24.76m, Aden. Can now be heard weakly on opening at 3.45 am. This one is gradually improving.

Radio Levant—8030kc, 37.34m, Beirut, Syria. A very good signal at 2.45 am. Is also heard well in New Zealand.

The following readers have reported stations in the above group: Messrs. Churchers, Clack, Leech, Tuxworth, Morris, Baker, Millowick, Gillett, Rochfort, Cushen, Moore, Hanson, Lee, Walker, Condon, Smart, Gaden.

NORTH AMERICA

WGEA—9000kc, 31.41m, Schenectady. Heard well in the forenoon. Opens at 8 am and is heard until 3 pm. Good signal.

WGEA—15,330kc, 19.57m. News is heard at good level at 12.15 am. Heard also at 7 am until closing at 8.30 am. Also a good signal.

WGEO—9530kc, 31.48m, same location. Can be heard in the forenoon from 8 am till 3 pm, and is now engaged in a service for Americans far from home. This new transmission opens at 8 pm and is heard at good level.

WNBI—11,890kc, 25.23m, New York. Audible at fair strength from 6.30 am and in addition at 5 pm on Monday afternoon, when they operate in lieu of WRCA.

WNBI—15,150kc, 19.81m, same location. Can be heard at 9 am when reception is good. At night is not in the best position for good reception.

WNBI—17,784kc, 16.87m, same location. Heard well at 11 pm on good nights. Has also been reported as heard at 9.15 am.

WRCA—9670kc, 31.02m, same location. Still puts out a fine signal for reception here in the afternoon at around 4 pm.

WCBX—15,270kc, 19.64m, same location. Heard at good strength here, giving news in German and English at 12.30 am. Can be heard in service to South America at 9 am.

WCBX—11,830kc, 25.36m, same location. This one has been used under the call WCRC in tests for overseas reception. These tests are conducted at 9 pm.

WCDA—17,830kc, 16.80m, same location. Heard well giving news in Spanish at 7 am onwards.

WLWO—15,250kc, 19.67m, Cincinatti, Ohio. News can be heard at 5 pm and at midnight. Strength is good at both times.

WLWO—11,710kc, 25.62m, same location. Fine signal at 9 am daily.

WLWO—9590kc, 31.28m, same location. This one gives a first-class signal daily at 10 am.

WBOS—11,870kc, 25.27m, Boston, Mass. Heard in parallel with WNBI at 8.30 am.

WBOS—15,210kc, 19.72 am, same location. This one in conjunction with WRCA at midnight.

WRUL—11,790kc, 25.45m, same location. A very good signal at 6.30 am, closing at 8.30 am.

WRUW—9700kc, 30.93m, same location. Another good signal in the morning on opening at 6.50 am.

WRUW—15,350kc, 19.54m, same location. Can be heard opening at 12.15 am, and also in a special broadcast at 2 pm.

WCW—15,850kc, 18.90m, New York. This one is used in parellel with WLWO, opening at midnight.

WJQ—10.010kc, 29.97m, same location. A very fine signal every night, and in addition carries very fine programmes. Opens at 8 pm and closes at midnight.

KWY—7184kc, 40.10m. This one has been reported as working with KGJ. This is an irregular schedule.

KGEI—15,330kc, 19.57, San Francisco. Opens in good style at 10 am and is good for the afternoon. Reaches its peak at about 2 pm.

KGEI—13,690kc, 21.01, same location. This one is now in commission once again. A very fine signal at 4 pm.

KGEI—7250kc, 41.38m, same location. Can be heard at from 5 pm until 7 pm and on some occasions later.

KRCA—6860kc, 43.73m, Bolinas. Used these days as a relay of KWID from 5 pm until 7 pm. Good signal.

KEZ—10,400kc, 28.85m. This one carries on when the 43.73m transmitter closes at 7 pm. This one put in a solid signal.

KET—9480kc, 31.65m, Used at times in the afternoon at 4 pm and is now used from 7 pm with KEZ. Stronger at night than in the afternoon.

KEQ—7370kc, 40.70m, Kahuku, Hawaii. Heard on rare occasions at 10 pm but is fair level.

KID—8420kc, 31.06m, Hawaii. Operates in point to paint transmissions with KZH, 'Frisco. These transmissions are heard at 10 pm.

KKQ—11,950kc, 25.11m, Bolinas. This one is also in the point to point hook-up on Sunday at 2.15 pm. Worth listening to.

KKZ—13,700kc, 21.90m, same location. Also in the same network.

KJE9—10.750kc, 27.01m, Los Angeles. Is heard on opening at 1 am with a very fine signal.

KRCA—9010kc, 33.29m. Another of the point to point stations which are heard closing at 4.30 pm. Good strength.

KWID—15,290kc, 19.62m, San Francisco. This one is providing us with excellent entertainment from 11 am until 7 pm. The station comes in very strongly.

CBFY—11,745kc, 25.54m, Montreal, Canada. Audible from 9.30 pm until 11 pm.

CFRX—6070kc, 49.92m, Toronto. Can be intercepted at 9.30 pm on opening, but is heard to better advantage at 11.30 pm.

CJCX—6020kc, 49.83m, Sydney, NS. This one is heard occasionally at 11 pm, but is never very strong.

CBRX—6160kc, 48.70m, Vancouver, BC. Can be heard on opening at 12.30 am, but fades out by 1.30 am.

VONH—5970kc, 50.25m, St. Johns, Newfoundland. Another of the elusive stations which is only heard with a fair signal.

XEXA—6170kc, 40.62m, Mexico City. Can be heard at good strength at midnight.

XEWW—9503kc, 31.57m, same location. Can now be heard from 2.30 pm to 4 pm and also at midnight.

XEQQ—9680kc, 30.99m, same location. Very fine signal from 3 pm to 4 pm. Is also on the air at midnight.

XEFT—9550kc, 31.40m, Veracruz. Reported as heard at 3 pm. This one closes at 4 pm.

The following readers have reported stations in the above group: Messrs. Churchers, Jones, Hanson, Clack, Lee, Foster, Walker, Leech, Tuxworth, Perkins, Perritt, Wilson, Millowick, Campbell, Gillett, Morris, Rochfort, Cushen, Moore, Condon, Smart, Gaden.

CENTRAL AMERICA AND WEST INDIES

HP5A—11,700kc, 25.64m, Panama City. Is heard at both 8 am and 11 pm at fair strength.

HP5G—11,780kc, 25.47m, same location. This one is heard on opening at 11 pm. For some reason we rarely get a decent signal out of this one.

HP5J—9607kc, 31.23m, same location. Yet another one whose signals are inclined to be on the weak side.

HH3W—10,130kc, 29.62m, Port au Prince, Haiti. Can just be discerned here at 6 am. Produces a fair signal at some locations.

HI2G—9295kc, 32.28m, Cuidad, Trujillo, Dominican Republic. This is the station so many people heard broadcasting such a lot of waltz music. They are heard at 7.15 am with a fairly good signal.

TIEP—6692kc, 44.81m, San Jose, Costa Rica. Has not been reported this month, but they open at 8 pm and should be audible at 9.30 pm here.

TIEMC—11,900kc, 25.21m, same location. Can be easily heard at just before midnight.

TIPG—9620kc, 31.19m, same location. Rolls in in nice style at 10 pm.

TILS—6165kc, 48.66m, same location. This is the time to hear this country as this station is now to be heard on Sunday afternoon at 3 pm. The strength is very good.

TI4NRH—9740kc, 30.80m, Heredia. Yet another one to be heard at 2 pm on Sunday. This one is also at good volume.

TGWA—9685kc, 30.08m, Guatemala City, Guatemala. Can be heard until 2 pm daily excepting Sunday, when they remain open until 4 pm.

TGWA—15,170kc, 19.78m, same location. To be heard only on Mondays at 7.30 am.

YNRS—8585kc, 34.95m, Managua, Nicaragua. A good signal to be heard at 11 pm. This one is easily recognised.

COBC—9695kc, 30.94m, Havana, Cuba. To be heard for the listening at 11 pm, carrying a good signal.

COBC—9365kc, 32.05m, same location. This one is fair at 8 am, and at 3 pm simply rocks in.

COCQ—8850kc, 33.90m, same location. Heard well at 7 am, 3 pm and 10 pm. We find that local interference affects this one, but that should not be the case in many other locations.

COCO—8700kc, 34.48m. This is a good one for the beginner, as much English is used. The strength is good at 10 pm.

COCX—9270kc, 32.36m. Another good one heard at 8 am and 11 pm. This is a very popular station.

COCW—6330kc, 47.39m, same location. Can be heard at 1 pm opening. Reaches very good strength when conditions are the best.

COCH—9435kc, 31.80m. Another station to be heard at night. This one is reported as heard at 9.30 pm.

COCM—9830kc, 30.51m, same location. Also heard at around 10 pm.

COCY—9246kc, 32.43m, same location. Heard at 8 am on some mornings.

COCY—11,745kc, 25.55m, same location. Heard on daily schedule and is audible here from 2.30 pm to 3.45 pm. English is also used from this one.

COK—11,620kc, 25.82m, same location. Another obliging station which can be heard at 8 am, 3 pm and 10 pm. The strength is very good.

COHI—6455kc, 46.48m, Santa Clara. Heard at fair volume at 10 pm, but usually fades by 11 pm.

The following readers reported stations in the above group: Messrs. Churchers, Foster, Perkins, Gillett, Cushen, Moore, Hanson, Walker, Condon.

SOUTH AMERICA

HCJB—12,460kc, 24.08m, Bogota, Colombia. Still heard on the Monday morning schedule. This commences at 8.30 am. This station can also be heard at night at 10 pm.

HJCD—6160kc, 48.70m, Bogota, Colombia. This one is being heard in New Zealand. The time is 12.30 pm. The time may come when we get those conditions here.
HJCF—6240kc, 48.07m, same location. Another one being heard by Mr. Cushen. He heard this one at 11.20 am.
HCJX—6018kc, 49.85m, same location. Heard at 10 pm, putting out a good signal.
HCQRX—5972kc, 50.23m, Quito Ecuador. Another station for Monday morning when it is heard at 8.30 am. Also audible at 9.45 pm daily.
CB960—9600kc, 31.25m, Santiago, Chile. One more for the list for Sunday afternoon. Heard at 3.15 pm at good strength.
CB970—9735kc, 10.82m, Valparaiso. A good signal at 9.30 pm daily.
CB1170—11,700kc, 25.64m, same location. Heard from 2 pm until closing at 2.30 pm.
CB11800—11,975kc, 25.05m, same location. Can be heard at 2.30 pm and also at 9.30 pm at good level.
OAX4A—6290kc, 47.69m, Chicaylo, Peru. Being heard at 1 pm with fine signal by Mr. Cushen.
OAX4J—9340kc, 32.12m, Lima, Peru. A good station which is heard well at 7 am, 2 pm, and 11 pm.
OAX4G—6190kc, 48.47m. Another one to mark off for Sunday at 2.30 pm. This station has been logged regularly for some time past.
OAX5C—9540kc, 31.45m, same location. Heard well at 4 pm each Sunday.
CXA7—9640kc, 31.12m, Colonia, Uruguay. Can be heard well at 6 am daily and at 4 pm on Sunday.
PSH—10,220kc, 29.35m, Rio de Janeiro. A weak signal that can be intercepted just before 9 am, Saturday, only.
PSF—14,690kc, 20.42m, same location. Heard at the same time as PSH.
PRE8—6105kc, 49.14m, Fortaleza, Brazil. A station which we have been hearing for some weeks past. This is heard at good strength at 7 am.
LSX—10,357kc, 28.98m, Buenos Aires, Argentina. Can be heard and copied weakly at 9 am.
LRX—9662kc, 31.06m, same location. This station originates the broadcast also emanating from LSX. This one is fair at 8.30 am until the end of the broadcast at 9 am.
The following readers have reported stations in the above group: Messrs. Walker, Moore, Cushen, Gillett, Millowick, Perkins, Foster, Condon, Gaden.

AFRICA

ZOY—6002kc, 49.98m, Accra, Gold Coast. Can still be heard weakly at 5 am.
ZRK—6097kc, 49.20m, Capetown, SA. At the conclusion of their programme can be heard relaying the BBC news at 6.45 am.
ZRH—6007kc, 49.95m, Johannesburg. Heard at good strength at 6 am. Closes at the end of the news relay.
ZNB—5900kc, 50.85m, Mafeking, British Bechuanaland. Heard in the relay at 6.15 am.
Post Office Station, Salisbury—7317kc, 41.0m. Schedule is 3 am to 6 am. Heard from time to time here. Usually on the weak side.
Bulawayo—3800kc, 79.0m. The schedule of this one is 3 am to 3.30 am, and 10.55 am to 11.30 am. The former is the most likely if at all.
SUX—7865kc, 38.15m, Cairo, Egypt. Can be heard at 6 am in an Arabic broadcast. The signal is a good one.
SUP2—6320kc, 47.47m, same location. A further Egyptian station to be heard between 2.30 am and 3.30 am.
Radio Cairo, 5980kc, 50.17m, same location. This one is to be heard on some mornings at 6 am.
Radio Addis Ababa—9625kc, 31.17m, Addis Ababa, Ethiopia. May be heard at 1 am daily. Closes at 1.30 am, signing off in English.
Radio Tananarive—6063kc, 49.48m. A country which has a great interest at this time. English announcements are made from this station at times. Heard well at from 12.30 am to 3 am.
Radio Tananarive—9690kc, 30.96m. This one has not been reported this month, but we expect to hear them again. The same schedule is operated as the sister station.
CR7AA—6300kc, 49.7m, Lourenco Marques, Mozambique. Heard at 7 am and also at 11 pm on closing.
CR7AB—3490kc, 85.92m. This one operates the same schedule.
CR7BD—15,250kc, 19.66 2. Also on the same schedule.
CR7BE—9840kc, 30.49m. News in English is radiated at 5.30 am, and the station closes at 6.30 am.
CR6RA—9470kc, 31.68m, Luanda Angola, PW Africa. A good signal heard at from 5.30 am until 7 am.
FZI—11,970kc, 25.06m, Brazzaville, French Equatorial Africa. Heard with a terrific signal at 5 am and 3.30 pm, when the news in English is read.
OPM—10,140kc, 29.59m, Leopoldville, Belgian Congo. Heard at fair strength prior to closing at 5.30 am.
VQ7LO—6060kc, 49.50m, Nairobi. Opens at 2.15 am with a poorer signal than usual. Closes at 5.15 am. See notes for the new frequency being used in addition to this one.

TPZ—12,120kc, 24.75m, Algiers, Algeria. News is given from here at 7.5 am and 5.45 pm.
TPZ2—8960kc, 33.48m, same location. Relays TPZ. This frequency is rather prone to interference.
CNR—8035kc, 37.34m, Rabat, Morocco. Audible from 6 am until 7.30 am, this one has never been as good on this frequency as the one it used to use.
FGA—9410kc, 31.88m, Dakar, Senegal. Opens at 5.15 am and is audible until 7 am and sometimes later.
The following readers have reported stations in the above group: Messrs. Perkins, Baker, Gillett, Walker, Condon.

AUSTRALIA AND OCEANIA

VLR—9580kc, 31.32m, Melbourne. National programme 6.45 pm to 11.30 pm daily. Closes at 11 pm on Sunday.
VLR3—11,880kc, 25.25m. National programme, 12.30 pm to 6.15 pm daily. 12.50 pm to 6.15 pm, Sunday.
VLR8—11,760kc, 25.51m, National programme, 6.30 am to 10.15 am daily. 6.45 am to 12.45 pm, Sunday.
VLG2—9540kc, 31.45m, Melbourne. To Eastern States of N. America, 9.25 pm to 10.10 pm. To SE Asia, 12.15 am to 1 am. This transmission is in Dutch, French, and English.
VLG6—15,230kc, 19.69m. To Western States of N. America, 2.250; 59 3.10 pm. To Tahiti, in French, 3.35 pm to 4.40 pm. To British Isles, 4.55 pm to 5.25 pm. To New Guinea, in Japanese, 6.15 pm to 6.30 pm.
VLG7—15,160kc, 19.79m. National programme, 6.30 am to 8.10 am, noon to 2.0 pm, 7 pm to 7.18 pm.
VLQ—9615kc, 31.21m, Sydney. To New Caledonia, 6.25 pm to 7.25 pm. This transmission in French.
VLQ2—11,870kc, 25.27m. To Western States of N. America, 1 am to 1.45 am. To SE Asia, 8.40 pm to 9.15 pm.
VLQ4—7220kc, 41.55m. Heard in a transmission in French, closing at 7.20 pm.
VLQ6—9580kc, 31.31m. Operates in the transmission for the British Isles from 4.55 pm to 5.25 pm.
VLW2—9665kc, 31.04m, Perth, WA. A session is conducted from this station in Dutch, Malay, French and English for listeners in SE Asia. The time is 11.15 pm to 12.55 am.
VLW3—11,830kc, 25.36m. National programme from 8.30 am.
FK8AA—6130kc, 49.94m, Noumea, New Caledonia. Heard weakly from 5.30 pm until they close at 6.25 pm.
The following readers have reported stations in the above group: Messrs. Lee, Hanson, Morris, Gillett, Millowick, Perkins, Jones, Churchers, Condon.

MISCELLANEOUS

OIX1—6120kc, 49.02m, Lahti, Finland. Can be heard at 1 am when the band is quiet.
OIX2—9500kc, 31.58m, same location. Heard well in the early morning at 5.30 am with fair signal.
OIX3—11,870kc, 25.47m, same location. This outlet is heard at good strength at 1.30 pm.
HER3—6165kc, 48.66m, Schwarzenberg, Switzerland. Heard from 6 am to closing at 7 am. French and German only from this one. Watch for tests from this country.
HVJ—6005kc, 49.96m, Vatican City. Can be heard some days prior to 5 am.
HVJ—9660kc, 31.06m, same location. Gives information regarding PO War at 3 am.
HVJ—11,740kc, 25.55m, same location. Also giving PO War information for Australia and New Zealand at 5 pm.
CSW6—11,040kc, 27.17m, Lisbon, Portugal. This one is operating at from 3 am to 6 am. The signal is always a good one.
CSW7—9740kc, 30.80m, same location. A very good signal on opening at 6.15 am and is heard well until 7.30 am.
Europe Revolutionary—9640kc, 31.12m. Heard only at about 4 am these days.
Emissora Nacional—7305kc, 41.07m, Ponta Delaga, Azores. Still being heard in the morning at 6 am until closing at 7 am.
Radio Metropole—11,740kc, 25.26m. Has been reported again as being heard at 1.15 am. The language used is Ukrainian.
Radio Caledonia—7010kc, 42.81m. Heard well at 6.45 am in English.
Radio Mediterrania—7035kc, 42.66m. Valencia, Spain. Can be heard in relay with the Malaga station from 6.30 am to 6.50 am.
Santander—11,780kc, 25.27m. This one can be heard giving news in Spanish from 2.30 am until closing at 2.45 am.
EAJ22—7040kc, 42.02m, Orveido, Also in the Malaga relay at 6.30 am.
Radio Malaga—7141kc, 42.09m. Yet another participant in the relay.
Radio Malaga—7206kc, 41.61m. This is the originating station of the news relays from these Spanish stations.
SPW—13,500kc, 22.2m, Warsaw, Poland. This one was reported some three months ago, and in a section of our contemporary from WA a signal is reported on this frequency.

TAP—9465kc, 31.70m, Ankara, Turkey. Still puts out a good signal at 5.15 am daily.
TAQ—15,195kc, 19.74m, same location. Heard well at 10.30 pm.
YUB—6100kc, 49.18m, Belgrade, Yugoslavia. Heard well at 7.15 am in the country
SBP—11,705kc, 25.63m, Motala, Sweden. Good signal at 3.56 am and 4.40 pm. News is given at both times.
SBU—9530kc, 31.46m, same location. Heard these days at 3 pm.
SBO—6065kc, 49.46m, same location. This outlet is audible at 7.15 am. The signal is a powerful one.
SBT—15,155kc, 19.80m, same location. Heard well at 1 am.
LKQ—11,735kc, 25.57m, Oslo, Norway. This Scandinavian is to be heard at 3 pm, but is not so strong as the Swedes.
PCJ—9590kc, 31.28m, Huizen, Holland. This one is thought to be out of service now.
PCJ2—15,220kc, 19.71m. Can be heard at 10 pm on most nights.
PCV—18.070kc, 16.60m. This one is heard weakly carrying the same programme as PCJ2.
Paris—6200kc, 48.39m, Paris, France. This one is again audible at 5.30 am.
Paris—9520kc, 31.50m, same location. Can be heard as early as 3 pm.
Paris—11,880kc, 25.25m, same location. We are hearing this one at 8.30 am, and from 5.45 pm to 7 pm.
Russia—15,230kc, 19.69m. A good signal at 7 am and also at 10 pm.
Russia—15,180kc, 19.76m. Heard well from 11 pm to midnight and in addition at 7.15 am.
Russia—13,010kc, 23.06m. This station is heard at 3 pm in special programme for England. This programme is also broadcast at 11.30 pm. A session is broadcast for the USA at 9.40 pm.
Russia—12,225kc, 24.54m. Heard in Russian language at midnight.
Russia—12,060kc, 24.88m. English is broadcast from this one from 11 pm.
Russia—11,885kc, 25.24m. Hear the CBS programme from this station at 10 pm.
Russia—10.040kc, 29.88m. The best signal from this one is at 11 pm. Also on the air with news at 3 pm.
Russia—7625kc, 39.21m. Good signal in news at 7 am.
Russia—6061kc, 49.5m. Can be heard weakly at 10 pm.
2RO3—9630kc, 31.15m, Rome, Italy. Heard best at 7 am and at 3 pm.
2RO4—11,810kc, 25.40m, same location. This one can now be heard at intervals right through the day.
2RO6—15,300kc, 19.61m. At 5 pm and at 10 pm.
2RO8—17,820kc, 16.84m. This station is very weak now at 10 pm.
2RO9—9670kc, 31.02m. This one is only a fair signal to some of them at 2 pm.
2RO11—7220kc, 41.55m. A good one at 6 am.
2RO18—9760kc, 30.74m. This one is being heard well at 9 am.
2RO?—10,330kc, 29.04m. Another new one at 7 am.
2RO?—6300kc, 47.60m. This new one is heard with fine signal at 6.45 am.
DJA—9560kc, 31.38m, Berlin, Germany. A good signal at from 3 am.
DJB—15,200kc, 19.74m. Heard well at 9 am, 1 pm and 10.30 pm.
DJC—6020kc, 49.83m. Another good one in the morning at 6 am.
DJD—11,770kc, 25.49m. Fine at 9 am and at 5 am.
DJE—17,760kc, 16.89m. Still audible at 10 pm. This one will last for some time yet.
DJH—17,840kc, 16.81m. We are not able to hear this one now.
DJL—15,100kc, 19.85m. News in English is heard at 10.30 pm.
DJP—11,855kc, 25.31m. At 6 am, 1 pm, and 10.30 pm is a good signal.
DJQ—15,220kc, 19.63m. This one is best heard at 3 pm.
DJR—15,340kc, 19.56m. A good station on the whole schedule from 3 pm to 2 am.
DJW—9650kc, 31.09m. The news is taken here at 5 pm.
DJX—9670kc, 31.01m. This one seems to be out of service.
DXJ—7240kc, 41.44m. Heard from 3 am, best at 6 am.
DXM—7270kc, 41.27m. A very fine signal at 5.30 am.
DXP—6030kc, 49.73m. This one is quite good at 6 am.
DXR—11.750kc, 25.51m. Heard satisfactorily at 3 pm and 9 pm.
DXX—6140kc, 48.86m. The news in English is heard from this one at 5.30 am.
DXZ—9570kc, 31.35m. English is also heard from this one at 3.30 am.
DXL7—11,855kc, 25.30m. This station is heard at 7.50 am on opening.
DXL24—9620kc, 31.18m. Also heard at 7.50 am relaying DXL7.
The following readers have reported stations in the above group: Messrs. Churchers, Leech, Perkins, Baker, Millowick, Gillett, Morris, Rochfort, Hanson, Lee, Walker, Condon, Smart, Gaden.

. . . MR L. B. GRAHAM,
Principal of the A.R. College.

Do you know?—

HOW TO ALIGN RADIO RECEIVERS

The performance of a modern superheterodyne receiver is determined, to a great extent, by the accuracy with which the tuning circuits are aligned. If a new receiver is to perform to the best of its ability, it should be carefully aligned and, to carry out this work efficiently, it is advisable to use a modulated oscillator.

EVEN if a set has been accurately aligned in the first place, the resonant frequency of the various tuned circuits will change slightly over a long period of time, due largely to effects of temperature and humidity, so that after a year or two it should be realigned.

In addition to an oscillator, another instrument which is of great assistance in aligning a receiver is an output meter. Unfortunately, in some respects and, perhaps, fortunately, in others, the human ear is not very sensitive in detecting slight changes in the strength of a sound. Even though the signal from a radio receiver may be increased to double its original power, this would only represent an increase of 3 decibels, which increase is just audible to the human ear.

OUTPUT METER

If, instead of judging the strength of sounds from a receiver by ear during the aligning process, we measure the strength with an output meter, this will accurately indicate even small increases or decreases, and will make possible much more accurate work.

An output meter is simply a form of AC voltmeter which usually has a condenser connected in series with it to prevent DC voltage from the plate circuit of the output tube, from affecting its reading. Any ordinary voltmeter or multimeter which is capable of measuring AC voltages can be used as an output meter by connecting a .5 mfd condenser in series with one of the test leads.

If an AC meter is not available, a DC meter can be used by employing it in conjunction with some form of rectifier. One very simple arrangement consists of any ordinary tube, connected as a diode by joining the control grid and all other elements together, except the filament or cathode. This arrangement is shown in Figure 1.

The meter can be any ordinary 0-1 d-c milliammeter or, for that matter, any milliammeter up to 10 ma is suitable. On the other hand, a DC voltmeter up to about 25 volts can be used, provided it has a sensitivity of 100 ohms per volt or more.

VALVE RECTIFIER

As the tube will only be operating for a short time, its filament can be operated from a dry-cell battery of suitable voltage, or if an AC tube is used, its heater can be supplied from the transformer in the receiver, or from any other convenient source. Incidentally, any of the 1.4-volt or 2-volt battery series will work quite well from a single 1.5-volt torch cell.

In using an output meter, one terminal should be connected to the plate of the output tube, while the other connects to the chassis of the receiver.

The first step in aligning a receiver by means of an oscillator is to carefully tune the IF transformers to the correct intermediate frequency. Practically all modern receivers are designed to use as intermediate frequency in the vicinity of the 460 KC. Two very commonly used frequencies are 455 KC and 462.5 KC. These frequencies have been carefully chosen so that no annoying whistles are heard when tuning to any of the important stations.

I. F. TRANSFORMER

The first step, then, is to decide upon the IF to be used, and to set the dial on the oscillator, so that it produces this frequency. If an oscillator has been carefully calibrated in the first place, no difficulty should be experienced in setting it to the desired frequency.

Now connect the output leads of the oscillator to the control grid cap of the IF amplifier and turn the receiver volume control well up.

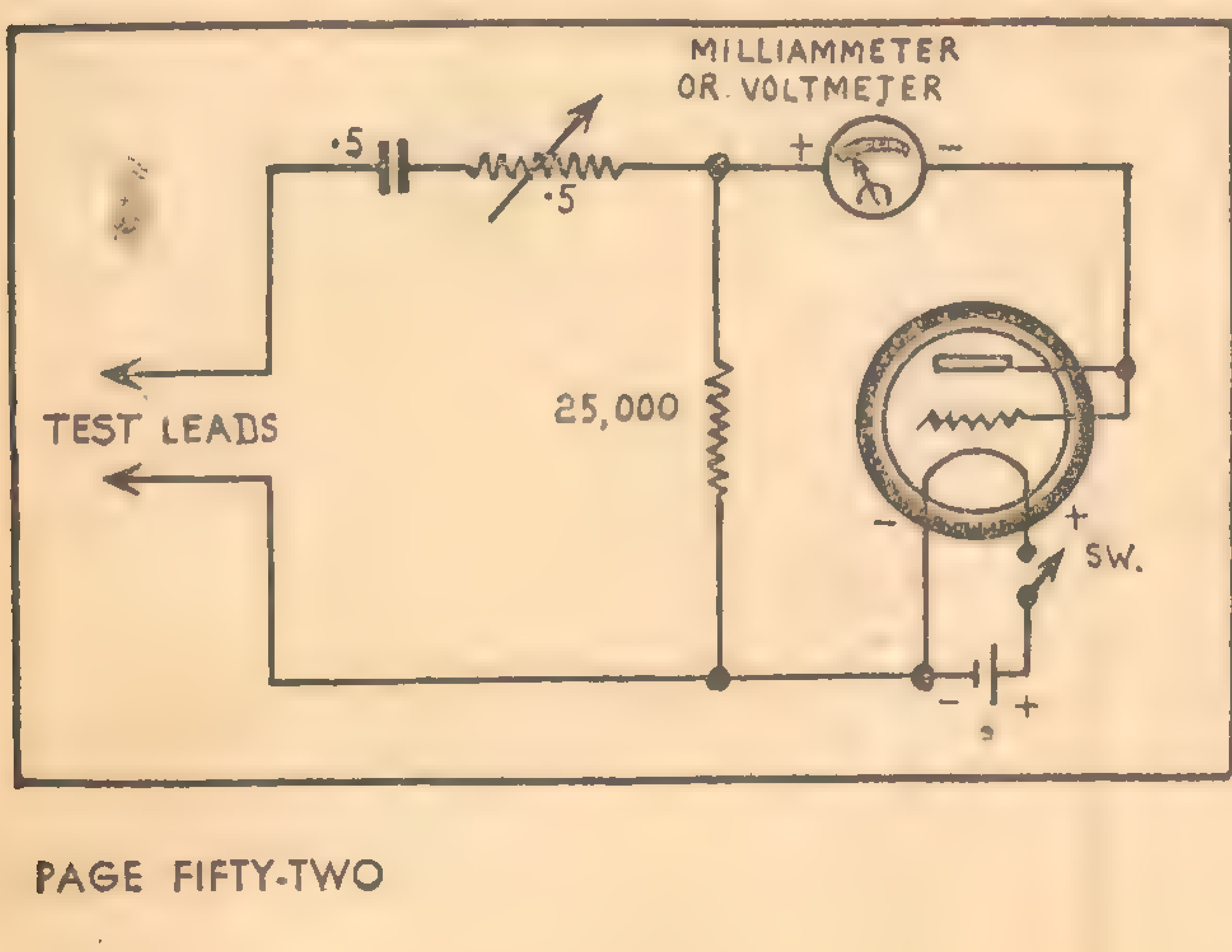
Set the attenuator of the oscillator so that the signal can just be comfortably heard from the speaker, or so that it gives a small reading on the output meter; now proceed to adjust the trimmer condensers in the last IF transformer for greatest output.

In sets employing automatic volume control, it is particularly important to turn the oscillator's attenuator to a position where it gives a very weak output. This will prevent the automatic volume control system from giving misleading results in setting the IF tuning condensers.

BEWARE OF ARCS

In adjusting the screws in the IF transformers, it is best to use a proper aligning tool or a screwdriver which has a few turns of insulation tape wound around it near the tip to prevent the screwdriver coming in contact with the adjusting screw and the metal can of the transformer at the same time. This precaution is particularly important when aligning battery-operated receivers.

After having aligned the second IF transformer, you should remove the oscillator's output leads from the grid of the IF tube and place it on the grid cap of the preceding tube. In



In the absence of a regular output meter or an a-c voltmeter, an ordinary d-c voltmeter or milliammeter may be pressed into service by operating it in conjunction with a valve rectifier. The 0.5 meg. potentiometer serves to vary the sensitivity. Calibration in volts is not essential.

nost cases, this will be the first detec-or or frequency changer. Now pro-eed to align the IF transformer im-nediately following this tube in the ame way as you aligned the other IF ransformer.

If the receiver employs 2 IF stages, o that three IF transformers are used, t will be necessary to place the out-out lead of the oscillator on the grid of the next tube working toward the erial, and then align the first IF ransformer in the same way as the other two.

GENERAL REMARKS

The majority of the IF transformers on the market at the present time are aligned in the factory to approxi-mately 460 KC, so that very little re-adjustment should be necessary in tun-ing these accurately to the desired in-termediate frequency.

Before starting to align the IF trans-formers, it is a wise precaution to short-circuit the oscillator section of the tuning condenser gang by means of a small piece of wire. This prevents the possibility of the oscillator fre-quency producing spurious intermedi-ate frequencies and giving misleading results.

After the IF transformers have been completed they should not on any ac-count be altered during the rest of the aligning procedure.

The next step is to connect the out-put leads of the oscillator to the aerial and earth terminals of the receiver, and to remove the piece of wire which was short-circuiting the oscillator sec-tion of the condenser gang. The oscil-lator should be carefully adjusted to produce a frequency of 1400 KC, and the receiver tuned to pick up this signal.

TUNING COIL TRIMMERS

In simple broadcast receivers, you will find a small adjustable trimming condenser mounted on top of each sec-tion of the tuning condenser gang, while in dual wave receivers the trim-ming condensers are usually mounted on the coils themselves, there being one set of trimmers for the broadcast coils, and one set for the short-wave coils.

In small sets, which do not possess an RF amplifying stage, there are two trimmers for each band, these tuning the aerial and oscillator coils, while in larger sets, employing an RF ampli-fying stage, there are three trimmers for each band, tuning the aerial, RF and oscillator coils.

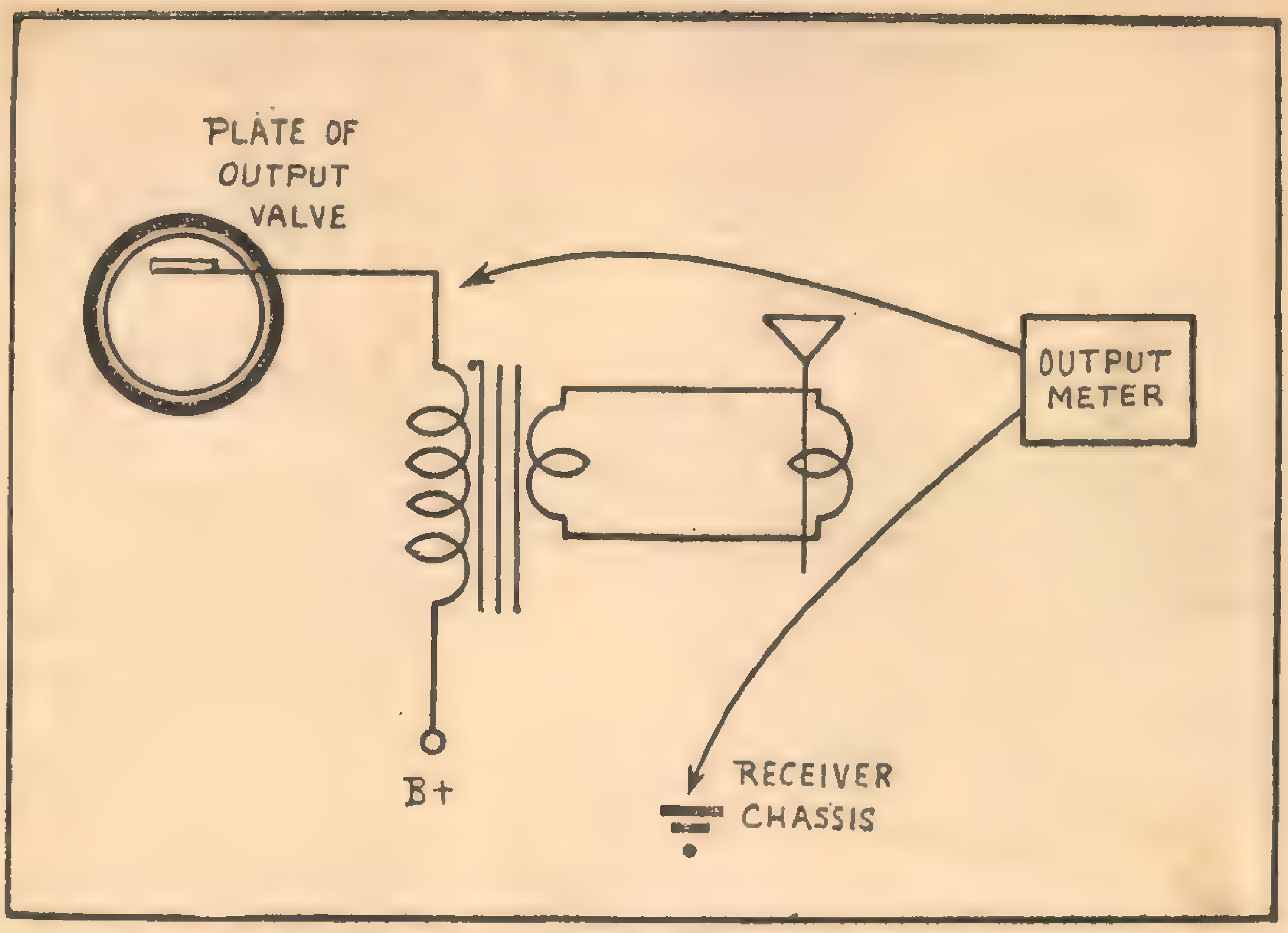
Now commence screwing the oscilla-tor trimmer about two-thirds of the way down, and then carefully tune in the signal from the test oscillator. Next adjust the aerial trimmer and RF trimmer, if one is used, for maximum output.

PADDER ADJUSTMENT

In carrying out this work the first time, it is necessary to completely dis-regard any markings on the tuning dial.

After having adjusted the trimming condensers at 1400 KC, the oscillator should be set to produce a frequency of 600 KC, and the receiver carefully tuned to pick up this signal.

If an output meter is used, adjust



Showing how an output meter is connected to a receiver. One lead goes to the plate of the output valve, the other to the chassis or to B plus. In either case the output meter should incorporate a blocking condenser to prevent it registering d-c volts. The meter may "kick" as connection is made, owing to the charging current of the condenser.

the attenuator on the oscillator so that the needle rests on some particular scale division, say, half-way up the scale. Now screw up the padding con-denser about quarter of a turn, and re-tune the oscillator signal by means of the tuning dial. Note whether the output meter reading is now stronger or weaker than previously.

If the output is stronger, continue to adjust the padding condenser in the same direction as before, but each time you make an adjustment to the padder, remember that it is absolutely necesssary to carefully re-tune the dial before judging whether the output has increased or not.

If the first adjustment of the pad-ding condenser resulted in a decreased output, it is necessary to unscrew the condenser about a quarter of a turn, and then re-tune the set before noting the output strength.

SETTING THE DIAL

By making adjustment of about quar-ter of a turn at a time, and carefully re-tuning the dial each time before the output strength is noted, you will soon find the point at which the pad-ding condenser permits the receiver to give its greatest output. The padder should then be left in this position.

Now that the padding condenser has been adjusted at 600 KC, you can pro-ceed to set the tuning dial so that its pointer falls correctly on the name of some station at the low frequency end of the band. To do this work, it is advisable to dispense with the oscilla-tor, connect an aerial and earth to the aerial and earth terminals of the re-ceiver, and tune in some station oper-ating on a frequency of about 600 KC.

In New South Wales, 2FC can be used. Now loosen the dial on the tun-ing condenser shaft, or loosen the pointer on the dial, and adjust the dial so that the pointer lies exactly on 2FC's marking when its signals are be-ing clearly received. In this way, you have set the dial correctly for stations at the low frequency end of the band.

The next step is to make the dial accurately indicate stations at the high frequency end. This is accomplished by tuning in some station operating at about 1400 KC, and nothing whether the dial pointer falls nearer the high frequency end of the dial than the cor-rect point, or whether it falls nearer to the centre of the dial than the cor-rect position.

READJUST TRIMMERS

If the pointer is nearer the high fre-quency end, it will be necessary to un-screw the trimmer on the oscillator coil slightly until the station is re-ceived at its correct position. For the time being do not worry about the aerial and RF trimmers. On the other hand, if the dial pointer were nearer the centre of the scale, it will be neces-sary to screw up the oscillator trimmer slightly until the station is found at the correct dial setting.

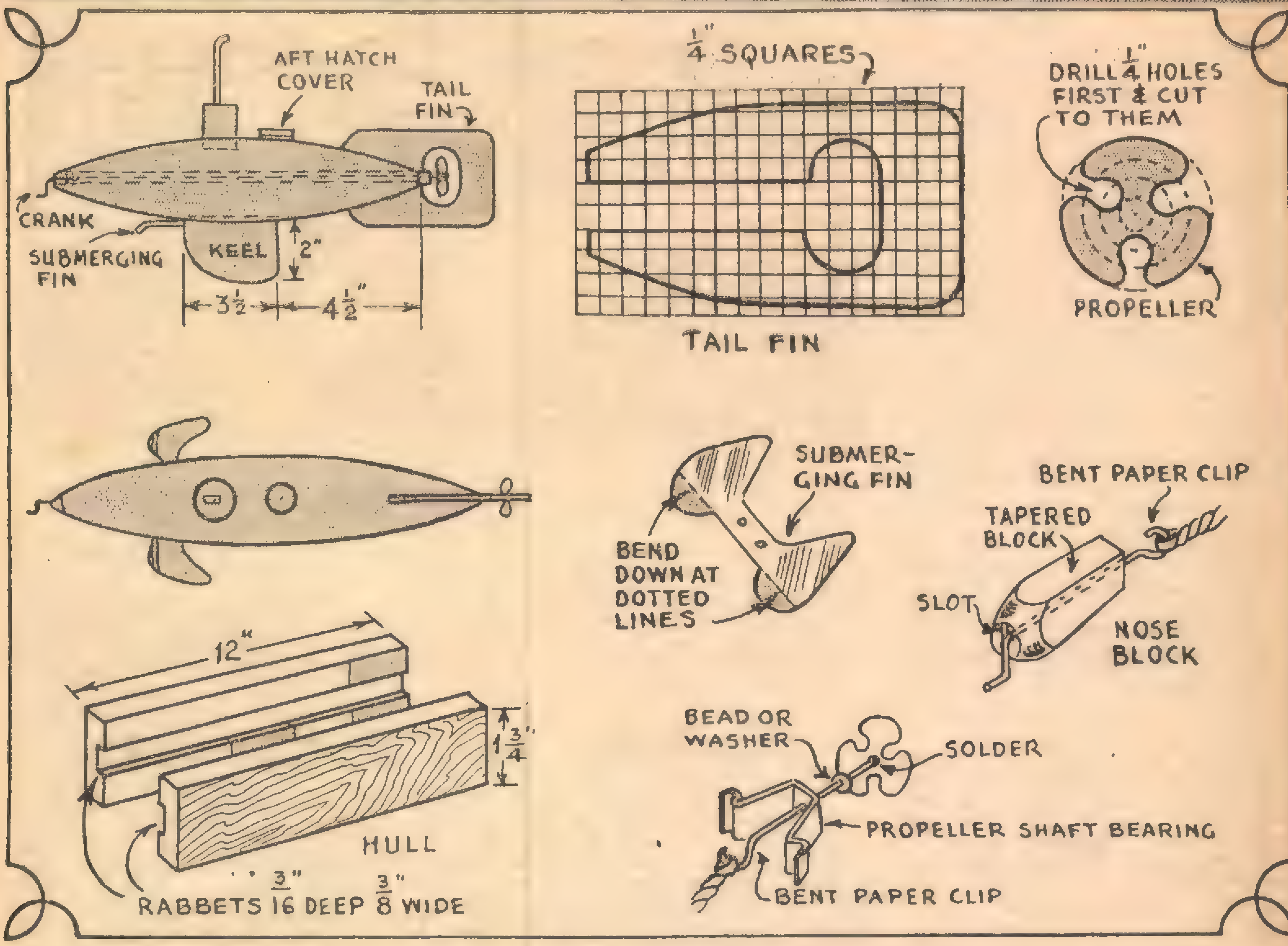
After the oscillator trimmer has been adjusted in this way, remove the aerial wire from its terminal and connect the oscillator's output leads in its place. The signal from the oscillator should then be used for readjusting the aerial trimmer and the RF trimmer, if one is employed.

This is done by carefully tuning in the oscillator's signal and, without al-tering the trimmer which tunes the oscillator coil, readjust the aerial and RF trimmer for maximum output.

After you have completed this, you may find that these adjustments have slightly upset the accuracy of the dial setting at the low frequency end. If this is the case, readjust the dial on the tuning condenser shaft until these stations are again accurately received,

(Continued on Page 55)

A MODEL SUBMARINE FOR THE KIDDIES



This month's simple project is a toy submarine, which is realistic in operation, simple to build and capable of giving many hours of enjoyment to the kiddies. It is a very topical toy, as Sydney's only taste of the world conflict so far has been confined to a submarine attack.

In some respects our model is similar to the type used by the Japanese in their attack on Sydney Harbor, particularly as to the shape of the hull, which is cylindrical and pointed at both ends.

To begin construction, first obtain two pieces of soft wood, such as pine, each piece measusing 1¾in. wide, 12in. long, and ⅞in. thick. On the inside face of each piece cut a rabbet 3-16in. deep and ⅜in. wide, as shown in the sketch.

A section aft, shown shaded, is sanded to receive the tail fin. Another section at the bottom centre, also shown shaded, is sanded to receive the keel. Next coat the inside faces with waterproof glue, and set under a weight to dry.

While the hull is drying, we can proceed to cut out the metal fittings required. The meal used should be about 18 or 20 gauge galvanised iron or brass.

First cut out the tail fin. This is done by marking ¼in. squares on the metal, then reproducing the shape of the fin by referring to squared drawing shown in this article. When the outline has been correctly sketched out on the metal, proceed to cut to shape with a pair of tin snips.

The keel is cut from a piece of metal 3¼in. by 2¼in., to the shape indicated in the side elevation sketch of the submarine.

by **W. G. Nichols**

The submerging fins are cut to the approximate shape indicated in the sketch. Two small holes are drilled in the centre so that the submerging fin can be attached to the bottom of the submarine by means of two small brass brads. The leading edges are bent down, as indicated by the dotted lines, so that the submarine will gradually submerge when set in motion.

THE PROPELLER

The propeller is the next on the list, and is cut from a 1in. diameter circle of metal. The details of the propeller should be laid out accurately on the metal, drilling the ¼in. diameter holes first and finishing the propeller to shape by means of the tin snips. A small hole should also be drilled in the dead centre of the propeller to take the propeller shaft. Before mounting on the shaft, the three blades of the propeller should be bent at equal angles, so that it can push the craft forward through the water.

The final sheet metal fitting is the

IT SUBMERGES LIKE THE REAL THING

propeller shaft bearing. This should be cut and bent to the shape shown in the sketch, and should be of such dimensions that it will be a spring clip fit into the shaft groove of the submarine. The bearing should have a small hole drilled in the centre so that it will be a snug fit for the propeller shaft.

We now return to work on the hull. This should be made cylindrical in shape, and pointed at both ends by means of a spokeshave. It should then be sanded well with medium grade sandpaper to a smooth, even contour.

Next, obtain a piece of ⅜in. diameter wood dowel, about 1½in. long, and, after drilling a ⅜in. diameter hole to a depth of about ¼in., fix the dowel firmly into the hole to form the conning-tower of the submarine, as shown in the side elevation drawing.

KEEL AND FINS

A wooded button is now tacked slightly aft of the conning-tower to represent the aft hatch cover. The keel is slid into the recess previously made for it in the bottom of the submarine, and held in place by two small brads. The tail fin is fitted to the stern of the submarine in a similar manner to the keel.

The submerging fin is fixed to the under side of the submarine, just forward of the keel, by means of two brads, driven through the holes previously drilled in the fin.

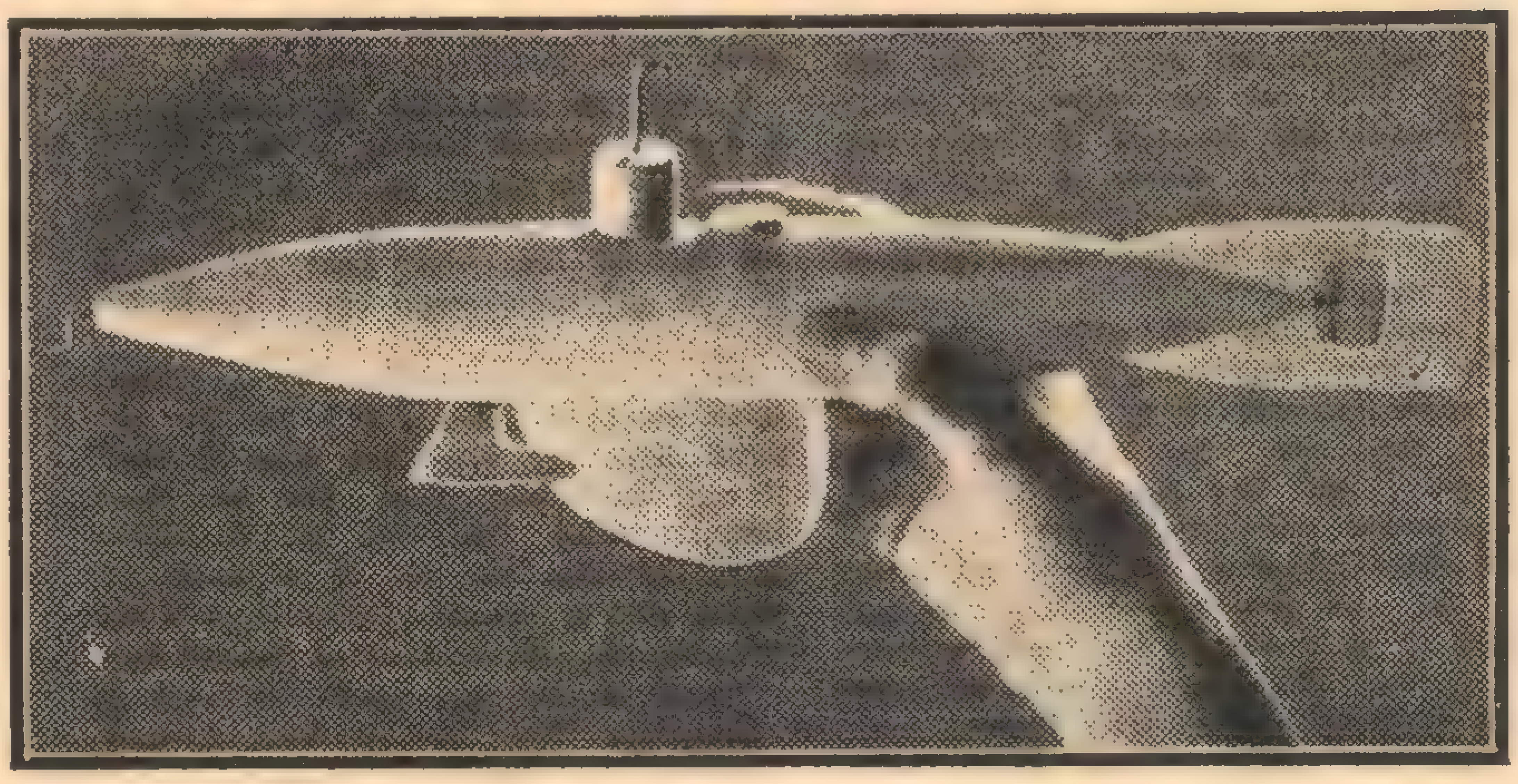
The periscope is fitted to the top of the conning-tower; it should be made ⅛in. round cane or very light metal tubing. Under no circumstances use anything heavy for the periscope. The hull and fittings can now be given a coat of battleship grey and put aside to dry.

Whilst the hull is drying, cut a nose block to the shape shown in the illustration, and to such dimensions that the square section will fit snugly into the ⅜in. square hole in the nose of the sub., and the rounded section will conform to the contour of the hull.

THE NOSE BLOCK

A saw cut is made in the end of the nose block so that the crank will fit into it whilst the submarine is in operation, and thus prevent the crank from unwinding the elastic. A small hole is drilled through the nose block and the crank bent to shape from a paper clip and fitted as shown in the sketch. A second paper clip is bent to shape of propeller shaft threaded through propeller shaft, and soldered to it.

To operate, slip four or five small rubber bands over the hook of propeller shaft, and pass them through hole in centre of hull. Clip the propeller and bearing into place, slip the other ends of rubber bands on the hook of the crank, and push the nose block into the hole. Hold the propeller firmly, and wind crank till rubber bands are fully wound.



Here is the completed submarine. Finished in a battleship grey, there is no mistaking its appearance. Having finished the construction, spend a few minutes adjusting the weight and the submerging fins so that it behaves in the most realistic manner.

Slip the crank into the slot in nose block, place submarine in water and release the propeller. The depth and angle of dive is adjusted by bending the submerging fins to the desired angle. As the rubber bands unwind, the submarine will slowly and gracefully rise again to the surface.

The weight of the metal and the buoyancy of the wood will have some effect on the performance, and you may find it helpful to add small counterweights to the keel.

ALIGNING RADIO RECEIVERS

(Continued from Page 53)

and repeat the process just described at the high frequency end, so that these stations are also received at the correct dial setting.

This completes the alignment of the broadcast section of a dual-wave set and the whole alignment procedure in the case of a simple broadcast receiver. If the dial, gang and coils match up properly all the stations should be received on the calibrated positions.

Most dual-wave receivers do not employ an adjustable padding condenser for short waves and this considerably simplifies the alignment of the short wave section. In aligning this section, simply connect the oscillator output leads to the aerial and earth terminals, and if the receiver covers the ordinary short wave band of about 16 to 50 metres, set the oscillator to produce a signal of 20 metres or 15 megacycles.

Now screw the oscillator trimmer condenser in or out until the signal from the test oscillator is received with the tuning dial indicating 20 metres. After this, adjust the aerial and RF trimmer, if one is used, for maximum output.

As there is no adjustable padding condenser, there is no need to align the short wave section at the low frequency end of the short wave band, so that the one adjustment at 20 metres completes the alignment of this section

With some test oscillators, the output impedance is quite different to the impedance characteristics of an ordinary aerial. This may affect the setting of the aerial coil trimmer, particularly on the short-wave band.

This point can be checked easily enough by connecting up the aerial and earth, and tuning in to some weak station towards the high frequency end of the respective bands. First, carefully note the setting of the appropriate aerial trimmer, and then try the effect of adjusting it in either direction.

If the alignment has been carefully followed out, and there are no other faults in the receiver, you can rest assured that your set is performing to the best of its ability.

BRITISH BOMBERS

(Continued from Page 15)

in reverse to the usual scheme. They are light grey above and dull black or deep blue below.

Last of the trio is the Blackburn "Botha" (lower right), a plane about which very little has been said since it was announced that it was finding its way into Coastal Command squadrons of the RAF.

A high-wing monoplane, the machine is powered with two 990 horsepower motors. Like the Beaufort, to which it is said to be comparable, it is designed for general reconnaissance and torpedo-bombing work.

When first drafted to squadrons, expert opinion declared this to be one of the finest, fastest and most efficient planes of its type in the world.

WORKSHOP

JOE'S COLUMN — About Coke Fires

JUST as I was settlin' down to hear my radio serial the other night, a ring came at the door. It was the young feller from next door. He was a newly-wed, and he and his bride had only moved in a couple of weeks back. He said he was sorry to bother me and all that, but as he had heard I was a handyman, could I give him some advice on keepin' a coke fire goin'?

He added that he and his wife were very disillusioned. They had heard how cosy coke fires were and had bought a grate and five bags of coke with pleasurable anticipation. But no sooner had they lighted it than it would slowly go out, and after a few chilly evenings, a lot of mess around the fireplace, they were very disappointed, especially with five bags of coke on their hands.

"Do you burn wood with it?" I asked. "Oh, yes," he said. "We've tried everything. We get air to it by opening the window, but that only makes us colder by letting the cold air in.

"Tonight," he went on, "we were so desperate that my wife suggested that we put the coke in the gas oven and heat it until it is red hot, then quickly put it in the grate and see if it would keep going, but I thought I'd see you and maybe you could tell me what is wrong."

So I went to his house, met his nice young wife, and had a look at their fireplace.

A good flow of air up through the chimney is essential for a successful fire, and a chimney is no more efficient than its narrowest point. I put my head in his fireplace and shone a torch right up his chimney. It had a lot of soot in it, but although it would be better if removed, it shouldn't have affected his fire so much.

I suggested that, next weekend, he get a long bamboo pole, or somethin' of the like, and tie an old sugar bag to the end, go up on his roof—wearin' rubber-soled shoes—and work the bag up and down his chimney after screenin' out the openin' of his fireplace to prevent the soot from spreadin' through the room.

I could see that their fireplace was of a sensible modern design, made so that the fire would get a good supply of air just where it needed it. It seemed to me that his fire should burn, so I asked him to get some wood and I would try it

He brought in about half a dozen small pieces of pine and I put that on some paper in his grate after clearin' it out, and then asked him for some heavier wood. He told me he didn't have any—the pine was all he used. He added that it burned brightly for a while, but after he put the coke on it went out.

"Well, there's your trouble," I said as I stood up. "You not only have to burn wood to start the fire, but you have to burn heavier wood to get the coke goin' and an occasional piece added now and again to keep it sort of interested in stayin' alight."

A REAL FIRE

So I brought some wood from my place and showed them a real fire. I made a good wood fire first, and I didn't put any coke on until I was sure the bigger pieces were well alight. I packed the coke around the wood, and just for luck I put another piece of wood on and more coke on top of that.

Boy, was it a fire! It must have done the young couple's hearts good. I told them to let it alone until it started to go down a little, then add more coke, and if it has gone a little too far add a piece of wood on top of that to draw the heat up through the new coke. Also I told them to occasionally stir up the bottom to let air into the fire and remove the ashes that have formed.

They warmly thanked me and I went home, leavin' a much happier couple—after showin' the husband how to make a toastin' fork out of a piece of wire.

Yes, it was worth missin' the serial.

Maths Problems

(Continued from Page 45)

of little interest from a mathematical point of view.

Having considered the r-f end of the receiver, we can pass on to the audio amplifier. Here, we have a 6B8-G used as a combined diode detector and audio voltage amplifier. The values for the various components are as recommended by the valve manufacturers and call for little comment.

In most valve data handbooks you will find a chart giving information as to the use of certain valves as audio amplifiers. The valve manufacturers have tabulated the correct circuit constants so that most satisfactory results may be obtained.

The .25 meg. plate load, 1 75 meg. screen dropping resistor, and the 2000 ohm cathode bias resistor are recommended values for the 6B8-G, and, because of this, it is not necessary to make any calculations.

OUTPUT VALVE

This only leaves the 6V6-G to be considered. Reference to the charts shows us that the recommended grid bias for a plate and screen voltage of 250 volts is —12.5 volts, and that the no-signal cathode current is 49.5 milliamps.

Using the now well-known Ohm's law formula, the cathode resistor works out at 253 ohms, so that a 250 ohm resistor is quite OK.

The 1.5 meg, resistor connected from the 6V6G plate to the 6B8G plate is to provide negative feedback. Although there are means for determining this value, the method of so doing is rather complicated and would be out of place here.

As we progress through this series, all such points will be fully covered. So, for the moment, you must take our word that this value, 1.5 meg., is quite suitable in this position.

As in the case of the r-f end of the set, there are resistor values which are important but of no immediate interest in an article on mathematics. However curious you might be about them, they will simply have to be passed over.

AMERICA'S VAST AIRCRAFT PROGRAMME

(Continued from Page 29)

makers' methods. They took the polished cylindrical barrel, an exquisite piece of steel forging, and cast it, a quicker and cheaper method.

A test was made of the forged steel cylinder and the cast steel one. Both cylinders were submitted to pressure until they buckled. The forged steel cylinder buckled like a sat-upon silk hat. The cast one buckled in regular corrugations. In some respects, if not, perhaps, in all, it was the better product.

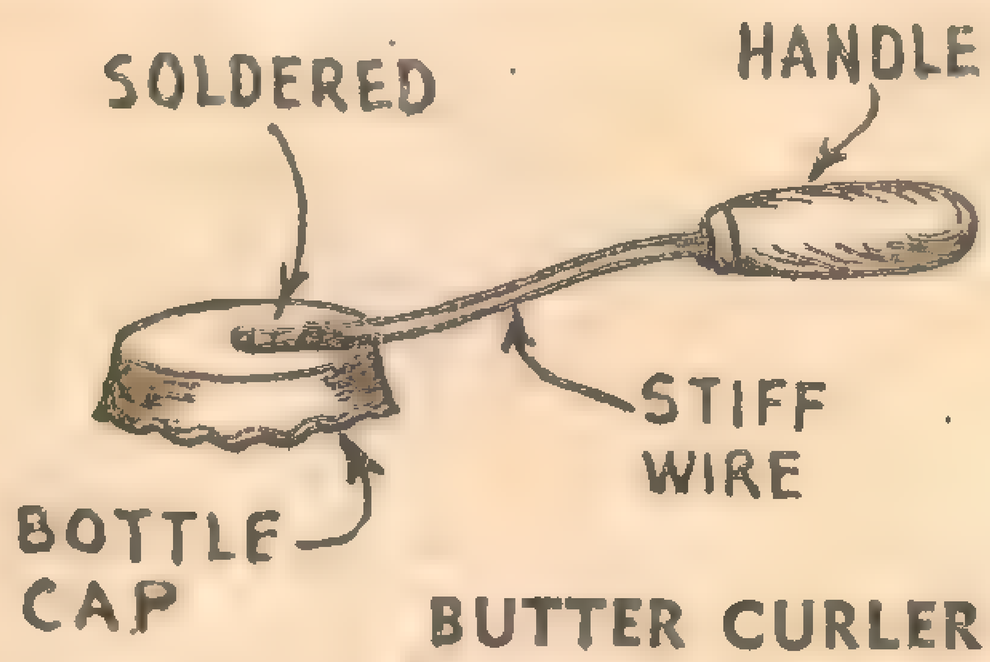
Besides the aeroplane sections that have been mentioned, the motor-car industry is in the production of aeroplane engines on a large scale. The Ford Motor Co. has built an immense plant to make air-cooled engines according to the Pratt and Whitney specifications, the Packard Motor Co. is making Rolls Royce engines to British specifications, General Motors is making the famous Allison liquid-cooled engine.

At the same time, Ford and Chrysler Motors are developing an engine which was designed from the first with quantity production in view. The Ford Company has plans completed for a factory, the largest factory of any kind in the world to make, not sections, but complete planes—and to produce them continuously at the rate of one bomber an hour!

There is no doubt the combined plane production of Britain and the US will this year exceed that of Germany and Japan. Now, what of quality? No matter what divergencies of opinion may exist between experts regarding the finest details of planes, you may take it that the American military plane already compares excellently with the best in the world, and is, in certain respects, definitely superior. In general performance it is at least equal. Its "availability" is higher than that of any European plane.

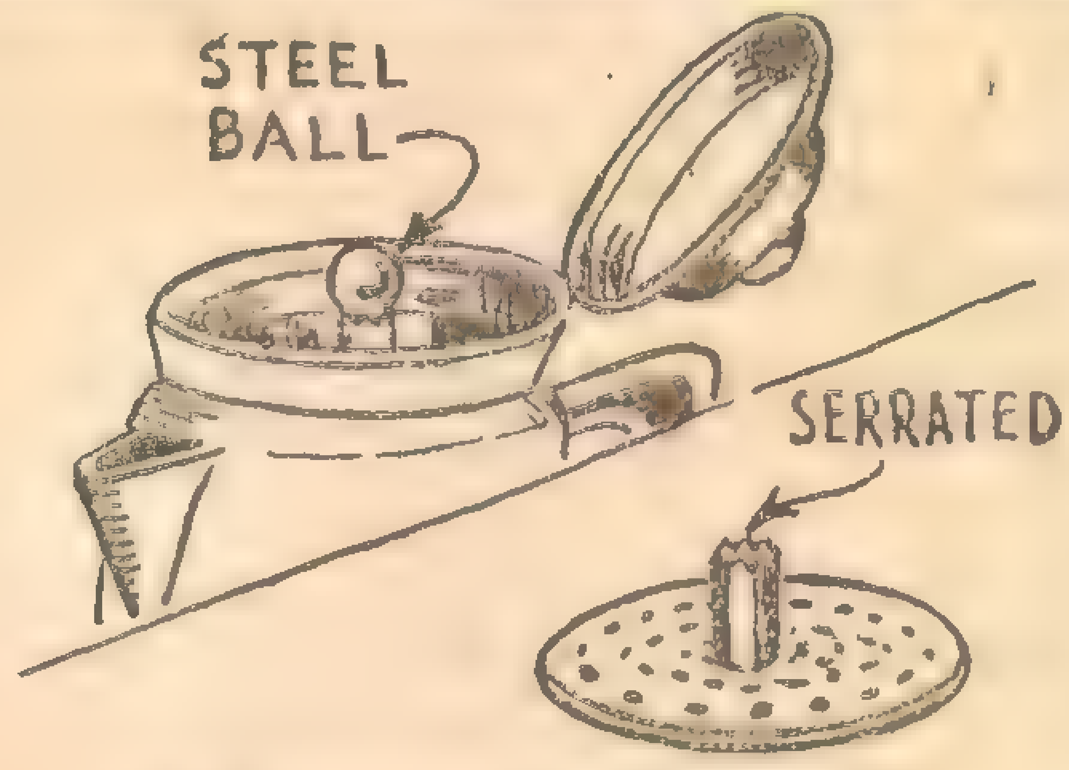
To even up, the United States will take the air—in air power we are bound to become the paramount force in the world. To comprehend that fully, look beyond the plane as a weapon. It is a weapon, of course, and a costly one, yet not exclusively a weapon like a tank, which is that and nothing more.

USEFUL HINTS FOR THE HOME HANDYMAN



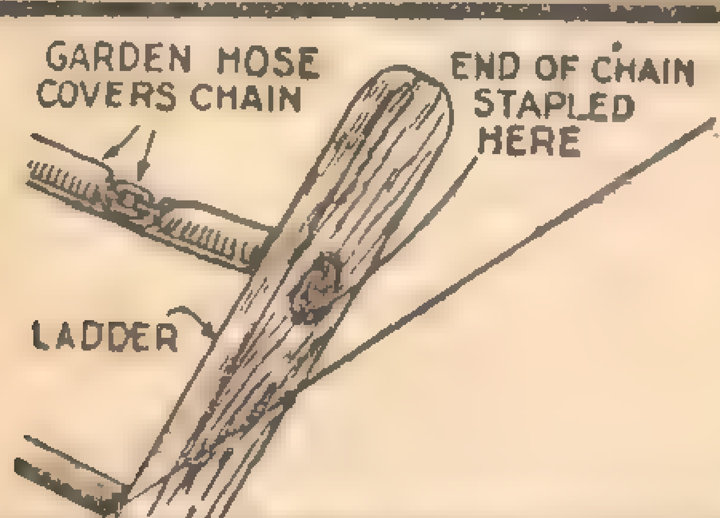
BUTTER CURLER

Solder a length of stiff wire to an ordinary bottle top, and add a wooden handle as shown in sketch. In use the curler should be dipped in hot water before using, so that the butter will not stick to the curler. The butter curls appear like fluted shells and are easily spread in the coldest weather.



PERCOLATOR HINT

If the top of your percolator is serrated with a three-cornered file and a half-inch steel ball placed on the top, as illustrated, the ball will deflect the rising hot water over the coffee, percolating it all evenly and thus avoiding any possible waste of coffee.

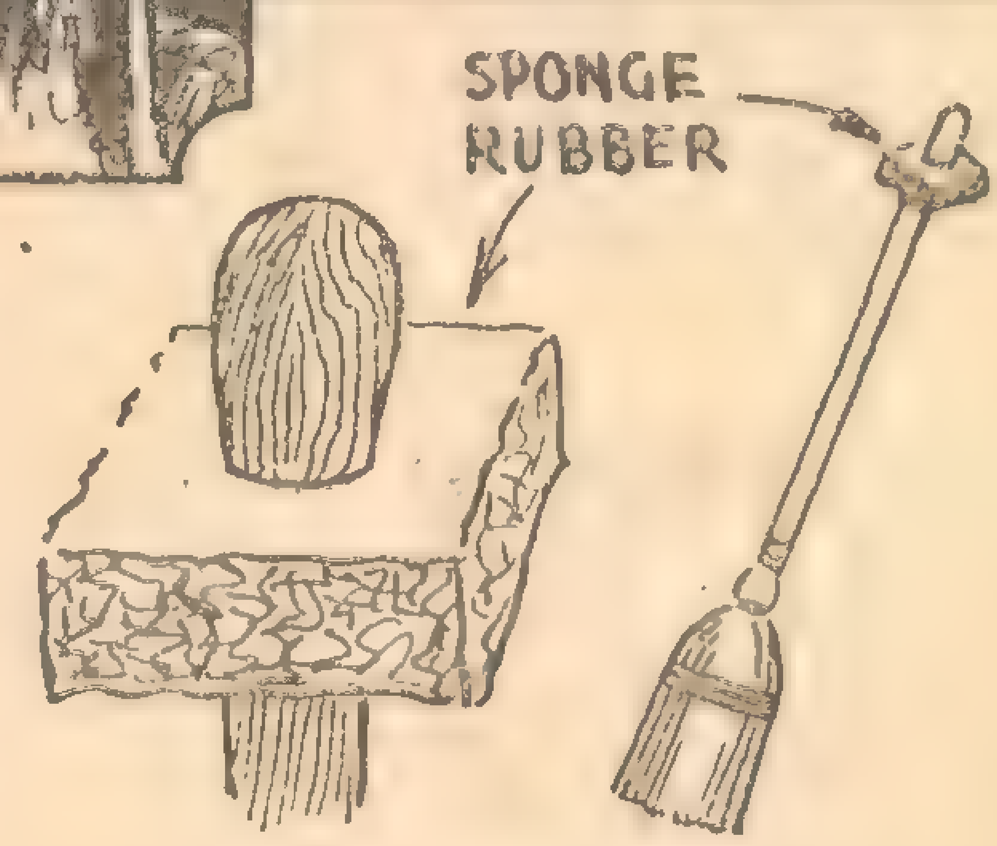


SLIP-PROOF LADDER

Ladders can be made safe for climbing trees, etc., by substituting a length of hose-covered chain for the top rung. The chain fits around the curve of the tree and the rubber hose prevents it from slipping.

BATHROOM SUGGESTION

To obviate the annoyance of having to grope around the bath for the soap while having a shower, sew a pocket to the inside of the shower curtain and the soap will always be on hand.



WALL PROTECTOR

To protect the wallpaper from knocks and bumps caused by knocking the handle of the broom up against the wall, slip a square of sponge rubber over the handle as shown in sketch, and the damage will be prevented.

BROADCAST BAND DX

by Roy Hallett

Again this month a fine batch of reports has been received from our readers. Many report some very interesting DX "catches," which we shall deal with below. Reports from readers are always very welcome, particularly those reporting reception of something new or out of the ordinary. Readers' criticisms of these columns are also very welcome—and helpful.

We have altered the presentation of our "Listen for These" column this month. From time to time we think it would be helpful, especially to beginners, if we publish complete lists of stations in certain countries which are likely to be logged in Australia.

This month, New Zealand and Asiatic countries have been listed. As the season alters, and other countries become audible (North America, European countries, &c.), we shall publish similar lists.

The two mystery stations, believed to be New Zealanders, have, to my knowledge, not yet been identified. Another reporter, Mr. Gillett, also reports hearing these stations. They are heard prior to sunrise on 690 and 740kc.

Mr. Bennett, of Queensland, reports hearing a lady announcer speaking in French at 6 am one day recently, on approximately 695kc.

CBM, MONTREAL

Dr. Keith Gaden, yet another Queenslander, reports hearing the Canadian CBM Montreal, Quebec, on 940kc. It is not very strong, he says, but some news items and musical numbers could be copied. The signal is rather erratic; some nights it is stronger than others. Yes, shortwave fans, CBM is the station often rebroadcast by CBFY on 25-metre band. I believe CBM opens at 9.30 pm.

A Hawaiian station has been reported testing on 1540kc, by two of our reporters. Mrs. Ruth Esterhuigen, SA, quotes the call as KFDL; Mr. Doug Berndt, Queensland, believes it to be KXEL. This is apparently a new one, and is something DX'ers will be able to chase. It is audible at night, and the signal appears to be fairly strong.

A Philippine Islander is being heard on approximately 610kc. Mr. Cunningham heard it signing off one Saturday at midnight, with the slogan, "Radio Manila," which, before the collapse of the Philippines, was the slogan used by KZRM, on 618kc. Mr. Conden, SA, reports logging this one, and quotes the call sign as KZRH. These programmes are rebroadcast on shortwave, 9640kc.

Apart from the stations listed under "Listen For These," the following have been reported recently, and may be logged during the next few weeks: XEAW Reynosa, Mexico, 1570kc, announcing as "International Radio, Dallas, Texas, USA." XEAW's studios and offices are in the latter city. KFBK Sacremento, Calif., USA, 1530kc; KOMA Oklahoma City, Okla., USA, 1520kc; KGA Spokane, Wash., USA, 1510kc; KDYL Salt Lake City, 1320kc, Utah, USA. These may be heard at night: KGU 760 and KGMB 590kc Honolulu, Hawaii, are both good when opening at 1.30 am; KGMB is also being heard at some locations just after sunset, around 6 pm.

READERS' REPORTS

This month the writer thanks sincerely the following, who have been thoughtful enough to send along their very welcome and interesting reports:—G. Bennett, Proserpine, Qld.; A. T. Johnson, Mayland, WA; R. Francis, Erskineville, NSW; Mrs. R. Esterhuigen, Milang, SA; D. Berndt, Maleny, Qld.; E. Suffolk, Summertown, SA; W. Ramsey, Auburn, NSW; A. S. Condon, Lura, SA; Howard Iffla, Narrikup, WA; Dr. K. B. Gaden, Quilipe, Qld.; F. J. Close, Gympie, Qld.; W. G. Norton, Swan Hill, Vic.; E. Tinning, Kew, Vic.; E. J. Perett, Marrickville, NSW; R. G. Gillett, Dudley Park, SA; J. V. Baker, Ryde, NSW; R. Cunningham, Horton, Qld.; M. Branks, Invercargill, NZ; N. B. Schilling, Wingham, NSW; W. Skelton, Queenscliff, Vic.; H. Parsons, West Pengelly, WA; D. Pratt, Pinjarra, WA.

LISTEN FOR THESE STATIONS

NEW ZEALAND

Stations at present heard from a few hours prior to sunrise are marked "A." Those heard well at night "B," and heard at both periods "C." All stations are on the air at night, but many are jammed by Australians on the same frequencies. Call signs in brackets are of stations on same channel.

2YA, Wellington, 570kc. (Australasia's most powerful radio voice, 60,000 watts). C.
1YA, Auckland, 650kc., 10,000 watts. C.
2YZ, Invercargill, 680kc. A. (2HR, 4AT.)
3YA, Christchurch, 720kc. C. (6GF.)
2YH, Napier, 750kc, A. (4QS.)
4YA, Dunedin, 790kc. A. (2BH, 6WN.)
2YC, Wellington, 840kc. C.
3ZR, Greymouth, 940kc. A. (4QR.)
1ZB, Auckland, 1070kc. A. (2000 watts.) 2RG, 6WB.)
2ZB, Wellington, 1130kc. A. (3CS, 6ML.)
3YL, Christchurch, 1200kc. B.
1ZM, Auckland, 1250kc. B.
4ZB, Dunedin, 1280kc. A. (3AW.)
2ZA, Palmerston North, 1400kc. (2PK.)
3ZB, Christchurch, 1430kc. A. (2WL.)

New Zealand also possesses several other lower-powered stations, but we shall not list them here, as they are not easily logged in Australia.

ASIA

This is a fairly complete list of Asiatic stations, which have been reported by Australian DX'ers. Try for them after the Australians close at night. Some of them may be heard till around 3 am. The best period for these is usually around midnight and 1 am.

Most of these carry Asiatic type programmes, but English is occasionally heard from many of them, particularly the Indians and, of course, Filipinos.

VUV, Hyderabad, India, 730kc. (not very strong).
VUT, Trichinopoly, India, 758kc. Good.
VUC, Calcutta, 810kc. Fair.
VUD, Delhi, 886kc. Fair on till well after 3 am.
VUW, Lucknow, 1022kc. Fair.
VUL, Lahore, 1086kc. Fair.
VUY, Dacca, 1167kc. Usually the strongest of the Indians.
VUB, Bombay, 1231kc. Not very strong.
VUM, Madras, 1420kc. Not very strong.
VUP, Pashawa, 1500kc. Jammed by 3AK, Melbourne, same channel.
"Radio Saigon," Saigon, FI China, 1000kc. Best in Western Australia.
XGAP, Peking, China, 640kc. Good.
XOJC, Nanking, China, 660kc. Not very strong.
XPRA, Kunming, 690kc. Very strong.
JTHK, Hong Kong, 845kc. Not definitely identified, weak signal (formerly ZBW).
XOJB, Shanghai, 900kc. Good (off 12.10 am).
XGOA, Chungking, 1200kc. Not very strong.
FFZ, Shanghai, 1420kc. Not very strong.
XMHA, Shanghai, 600kc. Erratic schedule, poor signal.
HS7PJ, Bangkok, Thailand, 825kc. Very strong at times.
KZRM, "Radio Manila," Philippines, 610kc. Off midnight, good. This call may be KZRH.
ZOH, Colombo, Ceylon, 700kc. Not very strong.
RW72, in Siberia, 577kc. Irregular schedule. Good signal.

ALL DX reports should be addressed to Mr. R. Hallett, 36 Baker-street, Enfield, NSW. Reports for the September issue should be posted to reach Mr. Hallett not later than August 1.

ANSWERS TO CORRESPONDENTS

NDER THE PERSONAL SUPERVISION OF THE TECHNICAL EDITOR

"Instable" (Rockhampton, Qld.) has built the Dual Wave Advance receiver with a me-made coil unit. The short-wave band dead with a 6J8-G converter, and little tter with an EK2.

A.: It is apparent that the short-wave coils e not right, although it is difficult to say st what might be the cause of the trouble. ng leads, bad lay-out, too little feedback the oscillator coil, poor tracking, incorrect nnections, &c., are all within the realm of ssibility. Short of writing a discourse on il design, we could not help you much.

D.E.Y. (Concord) makes a number of suggestions.

A.: Thanks, D.E.Y., for your interest and r the suggestions. We hadn't noticed the all error in the resistor color code, but we not think that many will be misled for ng. We agree that a small a-c receiver for adphones might be popular, and we will ke a note of it for a future occasion. The ea of mentioning the approximate cost of ceivers in R. & H. is likely to have repercussions, particularly in these days when ices vary from week to week. However, our vertisers will always quote a price on application.

N.J.S. (Swan Hill, Vic.) has a Duplex Single ceiver which does not perform too well when e local station is on the air.

A.: The selectivity of small receivers of this ass is severely limited, as you probably alise. The use of a wave-trap is certainly ther inconvenient on occasions, but it is all price to pay if it allows reception of her stations when the local station is on the r. You may be able to improve matters by perimenting with the aerial length and rection and by varying the aerial coupling the coil. As far as we know, there are television stations operating in Australia present, experimental or otherwise. In regard to the apparent reception of your local ation on 500 metres, we suggest that you ask e station engineers about it. It may be a urious emission.

H.W. (Captain's Flat) has built up the Super x receiver, which does not operate very well the s.w. band. He is also puzzled about e now-famous A-B-C station.

A.: Reference was made to the A-B-C station in the short wave notes in the June issue. identity is a mystery. The Super Six rever is obviously not operating as well as it ould on the s.w. band. The receiver may ed to be aligned accurately, if this has not eady been done. On the other hand, there ay be something wrong with the coil unit. We suggest that, the first chance you get, u have an expert look it over for you.

N.T.W. (Mount Perry, Qld.) has two midget lves which he would like to use in a small ceiver.

A.: Unless our memory serves us false, these lves are of very ancient vintage and are nong the first of the dull emitters. No doubt ey could be made to work in a small rever using a more or less conventional rcuit. Thanks for the subscription, which s duly been recorded.

F.J.M. (Canefield) asks a lot of questions. they are of more or less general interest, will do our best to answer them.

A.: The passage you quote from the Radiotron esigners' Handbook is probably meant to fer that amplifiers are not necessarily raight-line because they employ direct coupng. The plate and grid of successive valves ay indeed be tied together, but there must coupling between the two cathodes. In me direct coupled circuits the reactive components interspersed between the two cathodes obably have far worse frequency characterics than the simple coupling arrangement resistance coupled circuits.

(2) There would be no startling difference tween a direct coupled amplifier using triodes d a well-designed resistance coupled amplirs using valves such as the 6V6-G and ltage negative feedback. After all, the limitg factor on the performance of any good nplifier is the speaker system and the assoated acoustic problems.

(3) The various methods of feedback all ve peculiar advantages and disadvantages. is impossible to mention them here, but ay not look through the articles on the subject n last year in "Radio and Hobbies"?

(4) An improperly operated diode detector will cause a lot of distortion. A diode detector, operated under proper conditions, probably cannot be bettered by any other form of detector, even including the much-vaunted infinite impedance variety.

(5) A combination of two speakers handling different frequency ranges can be very good, but we do not say that it is better than some of the best imported speakers such as you mention. The pocket must be considered. Amplion or Rola may be able to give you the frequency response curves of a pair of speakers.

(6) The tone control unit you mention is probably as good as any described to date, and we have heard many good reports from readers using it. It can be used both with gramophone pickup and radio tuner, although with the latter tolerable treble boost may be limited by background noise, &c.

S9333 (AMF) built up a Pentagrid 34 receiver some time ago, but feels that it is not working as it should.

A.: Thanks for the encouraging remarks and for the suggestions. At the moment vibrators and batteries are both scarce, and we are waiting for some improvement in the position before describing any battery-operated amplifiers. Possibly you are expecting the wrong thing of your receiver. Merely switching on the extra valve will not greatly affect the output. However, it does increase the maximum undistorted output and shows up to advantage when you also turn up the volume control to listen to a programme at a high level. In other words, it affects the power output capabilities rather than the gain.

T.A.W. (Hulaeca, Qld.) has built up the four-valve receiver described in the February, 1942, issue, and is very pleased with the results.

A.: We are pleased to know that the receiver performed in such grand style. We doubt if we would have room to publish details of your home-made cabinet, but you could give us a brief description of it. If you are prepared to take the chance of your work going for nothing.

K.H.W. (Mayfield) has built up the one-valve receiver described in the August, 1941, issue of R. & H., and wants details of a short-wave coil.

A.: We are pleased to note that you got the receiver operating OK. The desired short-wave coil data is published in the July issue, as you probably note. At the moment we have no plans to describe the construction of simple microphones, although we will keep your request in mind.

J.B.B. (North Sydney) suggests that we publish the design of a short-wave receiver along the lines of the "Communications Five," but with perhaps an additional stage.

A.: Thanks, J.B.B., for the suggestion. The "Communications Five" is still a good set as far as it goes, but we understand your desire to have something a little more ambitious. We are giving some thought to the matter of a larger SW receiver, but we cannot make any promises at the moment as to when the description will appear.

G.N.W. (Mont Albert) asks some questions about an electric motor and about a circuit enclosed.

A.: In regard to the motor, you would be well advised to take it along to someone who has had experience with similar types. If the field magnets are solid and not laminated it will probably be rather hopeless in any case and may tend to overheat as a result of the severe eddy current losses. The circuit enclosed is quite OK, but the power output would scarcely be enough to drive a loud-speaker. The same is true of "Little Jim." The use of an audio transformer in the latter is not advisable, since the detector is a pentode. We note your remarks in regard to a particular feature, but, in the very same mail, another correspondent said how much he appreciated it.

L.W. (E. Preston, Vic.) makes some general comments.

A.: Thanks, L.W., for the comments and suggestions. If anyone desires to build up the "Little General" as a console receiver, there is really no need to alter the circuit. It is simply a matter of using a larger chassis and dial and perhaps a larger speaker. Yes, some of the commercial receivers on the market sound very "woofy" if you have been used to an inselective TRF receiver.

M.S. (Captain's Flat) has rebuilt his receiver and finds that it no longer performs as it should, except with the aerial and earth reversed.

A.: It is very difficult to say what has happened. It is possible that the aerial coil has become open-circuited or perhaps short-circuited. Check over this and see that the aerial terminal is not shorting to the chassis. It is possible that the aerial lead-in wire may be broken inside the insulation. That is about all we can suggest, but it certainly seems that the trouble is in the aerial circuit somewhere.

G.B. (Cleveland, Qld.) has a "Communications Four" receiver which ceases to operate when the .05 meg. potentiometer is advanced, the receiver having to be switched off and on again.

A.: The trouble is certainly mysterious, but we suggest that it might be due to a faulty detector valve. Try reducing the grid leak to 1.0 meg. If possible, try another valve in the socket. The size of the tuning condensers would effect the band coverage, but would have no bearing on the trouble complained of.

T.P. (Macksville) has some nice things to say about "R. and H." and makes a suggestion for an article.

A.: Thanks, T.P., for the encouraging remarks and the suggestion. We will publish a circuit and a short article as soon as possible. We agree that it would be generally useful. We would have no objection to a local paper reprinting the article you mention, provided due acknowledgement was given to "Radio and Hobbies."

H.I. (Narrikup, WA) asks a specific question.

A.: The idea of having two tuned r-f stages ahead of the converter in a superhet receiver is quite sound. However, you may have some difficulty in achieving stability, and great care will have to be exercised in regard to bypassing and shielding. Another major difficulty these days is that of obtaining a four-gang condenser. You will have to use an old four-gang or couple up two two-gangs. Your circuit is quite in order.

P.D. (Darwin) wishes to operate a small battery receiver from a vibrator unit instead of from B batteries, which are difficult to obtain.

A.: There is no need to alter the circuit in any way. If you obtain a six-volt vibrator unit you can feed the output to the receiver in the same way as from the B batteries. If you require a reduced voltage for the detector, it can be obtained from a high resistance voltage divider network connected between B plus and B minus. By using separate accumulators for the filaments and vibrator, you will avoid any trouble with hum. You may have some difficulty in obtaining a complete vibrator unit. We can only suggest that you write to one of our advertisers for details as to price, &c.

C.T. (North Sydney) has built up the 4/40 receiver, but apparently has the I-F transformers a long way off the correct frequency.

A.: If you will accept our advice, you will take the receiver along without further ado to a serviceman and have the I-F transformers correctly aligned. This will probably be a lot less expensive than buying a new set of transformers, which will in any case have to be peaked up. We suspect that the receiver may also be oscillating, although it is difficult to say until the intermediate frequency is corrected. It is usual to shield the "hot" leads to and from an audio volume control and the input leads to an audio amplifier. As far as other leads are concerned, it depends entirely on circumstances. The "Serviceman" article has been suspended (a) because of lack of space, and (b) because the company concerned has discontinued receiver servicing for the duration.

L.W. (Auburn) has an "Inversed Four" receiver which he would like to modify in order to receive short-wave stations.

A.: It would be possible to rebuild the receiver, using plug-in or switched coils and including reaction. However, this would be quite a job, and the results would be entirely dependent on how well you had everything adjusted. We suggest that a better plan would be to build up a separate short-wave converter, as described in the current August issue.

SHORT-WAVE REPORTS

Mr. G. Rhodes (Canberra, ACT): Many thanks for your letter. We are hoping to enlarge on our notes concerning stations on the lower frequencies, provided sufficient listeners are interested. The log is very interesting and we will be glad to make use of it. Best wishes.

Miss D. Sanderson (Malvern, Vic.): Pleased to read that you heard the broadcast from KKQ regarding the bombing of the volcano. We heard this at very good strength. Hope to hear from you again in the near future.

Mr. B. Cragen (Bellevue Hill, NSW): Although you are a new correspondent, we are afraid that you are hardly a new listener. We are pleased to hear from you at last. You certainly seem to get around this air a fair bit. Thanks for the details of KWID. Will be glad to hear of your receiver.

Mr. N. Gunner (Stanmore, NSW): We are very interested in the report of stations received on the Little General. The log shows that the set is operating well over the whole range of the coils. Keep it up.

Mr. E. L. Fleming (Burwood, Vic.): We are writing to you as we are afraid that a letter we sent some weeks ago was not delivered. The mystery station is still a mystery as far as we are concerned. The Americans are certainly coming in well these days. Thanks for the log. Will be glad to hear of you again.

E. J. Perritt (Marrickville, NSW): Thanks for the report and for the details of the aerial you are using with some success. We may be tempted to try the arrangement out one of these days, as we are cramped for room here. Hope to hear from you again.

M. Morris (Newcastle, NSW): We are very glad to hear from you, as we had wondered what had happened to you. The report is very useful, as you are the first to report the new American. Thanks very much.

G. Wilson (Albert Park, Vic.): Thanks for the letter giving the information, but we had already interpreted the meaning behind the incorrect statements. We will write you as regards the other matter.

R. Simpson (RAAF): Thanks very much for the letter and the expressions of goodwill. Glad to hear that you are well again and that you are still receiving a few veri's from time to time. We are writing in the near future. All the best.

A. R. Smith (Cessnock, NSW): We are sorry that we cannot give the information you require, as it is the country and not the station which would be in the Postal Union. Thanks for the remarks about our magazine.

J. Baker (Ryde, NSW): Your letters are very interesting. We suggest that you send them direct to our home address, which appears in the notes each month. Glad that you enjoy the humor of the Tokio stations. Thanks for the log.

S. Millowick (Mt. Gambier, SA): Your very comprehensive log is very useful. You are certainly hearing them these days. Try again for ZNR2, as it should be audible down there. Regards.

G. Cooke (Epping, NSW): Glad to hear from you as a newcomer, and welcome to our ranks. We would like to hear the set with the 2 RF stages, especially on some of the off periods. Hope that you are successful with your cards. If you want any addresses at any time we will only be too pleased to supply them.

R. Campbell (Kelvin Grove, Q.): Glad to see you supplied the ex-ham call, as I thought we knew the name. The schedule you sent in is very valuable, as it fills in a few gaps in ours. We are also writing to you soon. Best wishes.

Sgt. R. K. Clack (Home Forces): Glad to hear from you again, and to hear that you are still getting among the stations. Sorry to hear of the mishap with the receiver. You were quite right about the BBC station; we heard them too late to include in the last issue, but you will see it reported in this one. Thanks for the log and the letter.

J. A. Leech (Guildford, NSW): Thanks for your letter, and welcome to our pages. Your log is very good, and we hope to have many more like it from you. We are familiar with reception conditions in your locality. Glad you like our magazine. Best wishes.

R. N. Tuxworth (Sarina, Q.): Another first report for which we are very grateful. We are glad that the new set is operating well, and that you are receiving the short-wave stations well. We note your remarks, and will certainly reply to you by mail when we get a few spare moments.

H. Perkins (Malanda, Q.): Thanks for the comprehensive log you turn in. We are sorry that you did not get my letter, but we will have another try. Reception seems to be quite good up your way, and is, of course, just as interesting as ever. Will be glad if you will carry on with the way you report as at present. Best wishes.

S. Jones (Punchbowl, NSW): Thanks very much for the letter and for the information you enclosed. We had heard the station concerned, but not as recently as you. Will be glad to hear from you at any time.

R. M. Churchers (Devonport, Tas.): Your very fine log received. Welcome to our pages. The set you have is undoubtedly a very fine one, and you should be able to turn in some fine logs from month to month. Write whenever you can. Best wishes.

M. Hunt (Home Forces): We hope that the trouble has disappeared and that the receiver is now operating in a satisfactory manner. It is always well to make certain that all connections are made properly. Thanks for your letter, and we hope that we will hear from you again in the very near future. Best wishes.

D. McKinnon (Strathfield, NSW): Thanks for your letter and for the remarks. You are welcome to come over to see me at any time. We are usually at home at the week-end. Best wishes.

Broadcast DX

Mr. Gordon Obey (Bronte, NSW): Always very pleased to receive your notes. You certainly have a splendid lot of QSL's at your QRA. Let's hope that after this crazy war has finished you will be able to become a ham. Yes, many of our Aussies send out very attractive QSL cards.

Mr. A. W. Pearson (Temora, NSW): Yes, your note was very welcome indeed. I hope the weather conditions soon improve and enable you to go after DX in earnest. I'm sure we all hope that it is not long before we hear your VK2KD back on the job again.

N. B. Schilling (Wingham, NSW): Thanks a lot for your report. As usual, it was very interesting. You, too, seem to enjoy an amazing daylight reception. I can just hear 2YA at noon on occasions. I wish I could hear it at the strength you hear it.

W. Skelton (Queenscliff, Vic.): So glad you got your verification from KFBK; I have just received mine, too. In the letter I received from KFBK they told me they had also verified your report. Your reports are always very welcome, old chap.

T. Tinning (Kew, Vic.): Many thanks for your welcome report, Ted o.m. All the very best with the work in your weekly. Here's hoping it's not long before the "Bulletin" is back on the job again. 73's.

Dr. K. B. Gaden (Quilpie, Qld.): Glad you heard the session from 6KY. I hope 6KY's QSL is by no means the last Broadcast Band verie you receive. So glad you like the SW and DX pages of our magazine.

D. Pratt (WA): That interesting letter of yours was very welcome. I sincerely hope the scraps of information I sent by mail were of interest. We now have quite a number of first-class reporters in your State.

M. Branks (Invercargill, NZ): Thanks so much for specimen copy of "DX'Tra." It is certainly a fine job. You DX-ers on your side of the Tasman certainly do have some splendid signals from overseas. Care to swap QRA's for a while? Hi! Your report was very interesting indeed, Merv.

H. Parsons (West Pengelly, WA): "Broadcaster" is certainly a jolly fine magazine. Thanks so much for specimen copy. Thanks also for details of the Short Wave League of Western Australia. Your reports are always welcome and very interesting.

A. T. Johnson (Maynads, WA): Many thanks for your interesting letter. That SWL card of yours is certainly a "winner." Other DX-ers may have cards to exchange, so I'll quote your address, as requested on your card, 20 Ferguson-street. Your report was also very welcome. Keep up the good work, 73's.

G. Bennett (Proserpine, Qld.): Glad indeed to hear from you again, o.m. Have (when writing) not heard that mystery French speaking station on about 690kc., 6 am, yet. Thanks for tip on this mystery. Such tips are greatly appreciated. All the best.

R. Francis (Erskineville, NSW): Your letter was very welcome; it's a pleasure to help any DX-ers with their little problems, so I was only too pleased to lend a hand in your case. No, no stamps or IRC's are necessary for return of QSL's from most NZ stations.

Mrs. Ruth Esterhuigen (Milang, SA): Many thanks for your interesting report. You and your husband certainly get pretty good results with that set of yours. I hope the "fish" continue to nibble.

W. Ramsey (Auburn, NSW): Glad to hea[r] from you again. You certainly have a goo[d] log of Asiatic stations. Your location appear[s] to be very similar to mine with regards to DX.

E. Suffolk (Summertown, SA): Reports fro[m] you and your pals, Dudley and Wally, ar[e] always welcome. I would like to be able t[o] publish your and other reporters' letters i[n] their entirety, but space at present does no[t] permit me to deal more fully with reports but these things just cannot be helped thes[e] days.

D. Berndt (Maleny, Q.): Jolly glad to hea[r] from you again, old chap. You certainl[y] make a good job of your reports; your letter[s] always contain plenty to interest me, and always endeavor to use as much of the[ir] contents as possible.

H. Iffla (Narrikup, WA): Very pleased t[o] hear from you again, o.m. You are anothe[r] thinking about Australian QSL cards. Ye[s,] most of our Aussies send out fine card[s,] sometimes long letters, in reply to correc[t] and useful reports.

F. J. Close (Gympie, Qld.): Very please[d] to receive another interesting and welcom[e] report from you, old man. As usual, you[r] report contained plenty to interest me. have received a verie from your Gymp[ie] station, 4GY.

W. G. Norton (Swan Hill, Vic.): Glad th[e] aerial is OK now. The two stations afte[r] midnight you mention may be 6WF, Pert[h,] 690kc., or XOJC, Nanking, 660kc. The othe[r] may be 6WN, Perth, 790kc. Don't know th[e] one on 540kc.; it is a bit of a mystery a[ll] right. All the best.

E. J. Perrett (Marrickville, NSW): Gla[d] indeed to hear from you once more. Th[e] aerial system you wrote about is very in[-]teresting. I have not tried it out yet. I ma[y] be able to mention it in the DX page som[e] time.

J. V. Baker (Ryde, NSW): Glad you hav[e] received your 3AK card. As far as I know the police stations don't verify. I sent report to VKG, but got no reply, and hav[e] heard of no one else getting one. I wa[s] very pleased to receive the note from yo[u,] old man.

R. G. Gillett (Dudley Park, SA): Glad t[o] receive your report; you certainly have good log of NZ and Asiatics. So very gla[d] you like the DX Page.

R. Cunningham (Horton, Qld.): Your repo[rt] was very welcome. I guess "Radio Manila" would be KZRM. Good work, glad you logge[d] it. Hope you continue to enjoy the DX Pag[e].

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